NATIONAL MUSEUM OF VICTORIA

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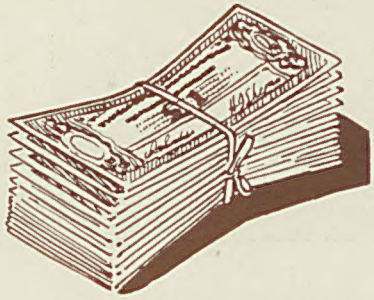

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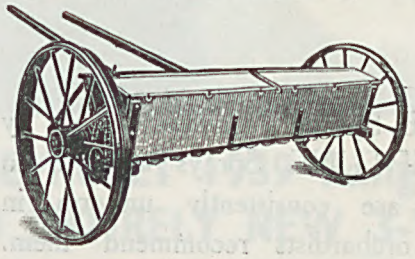

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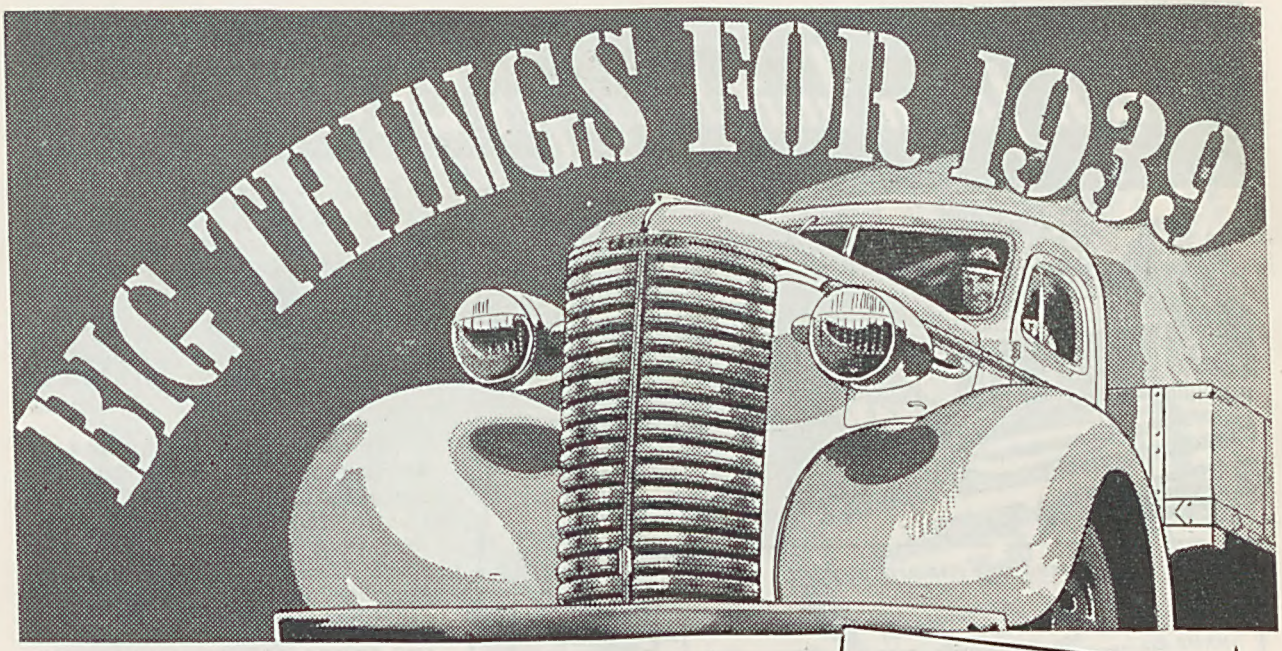

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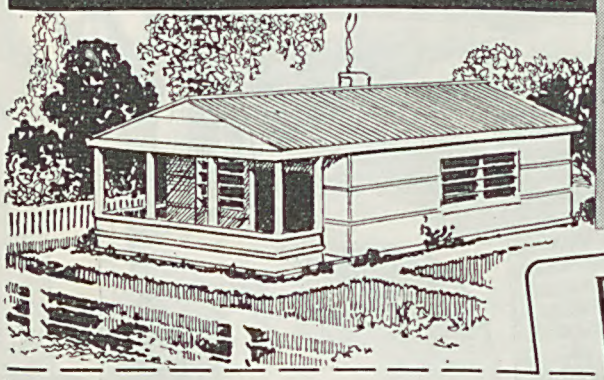

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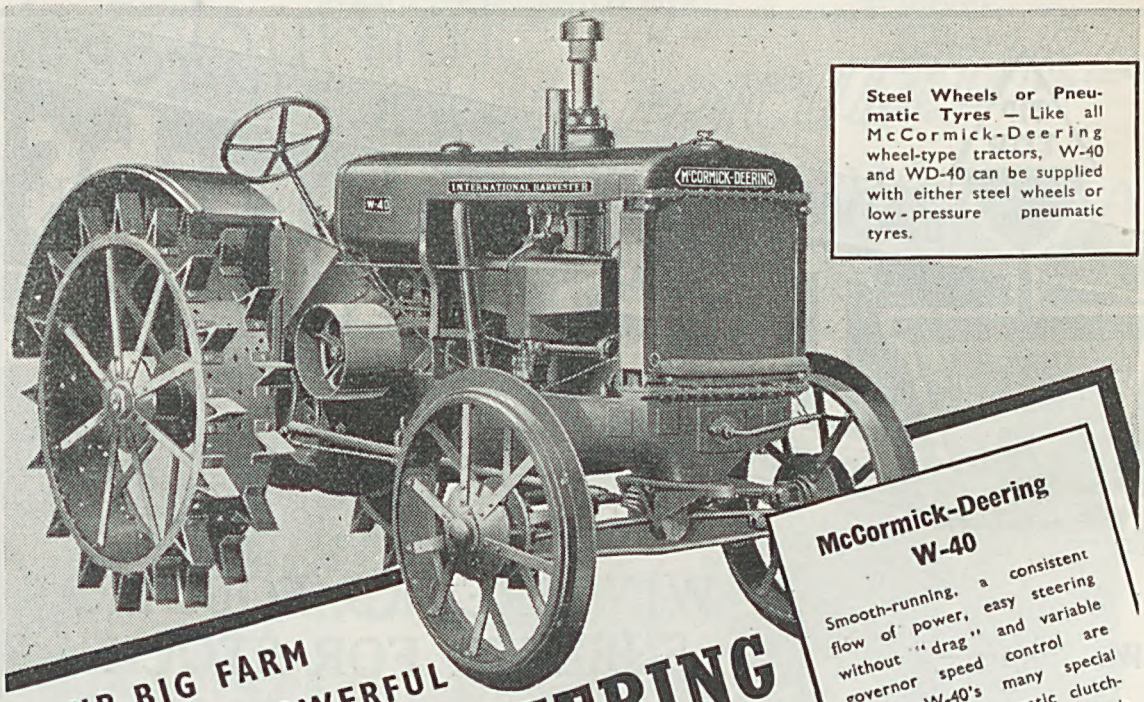

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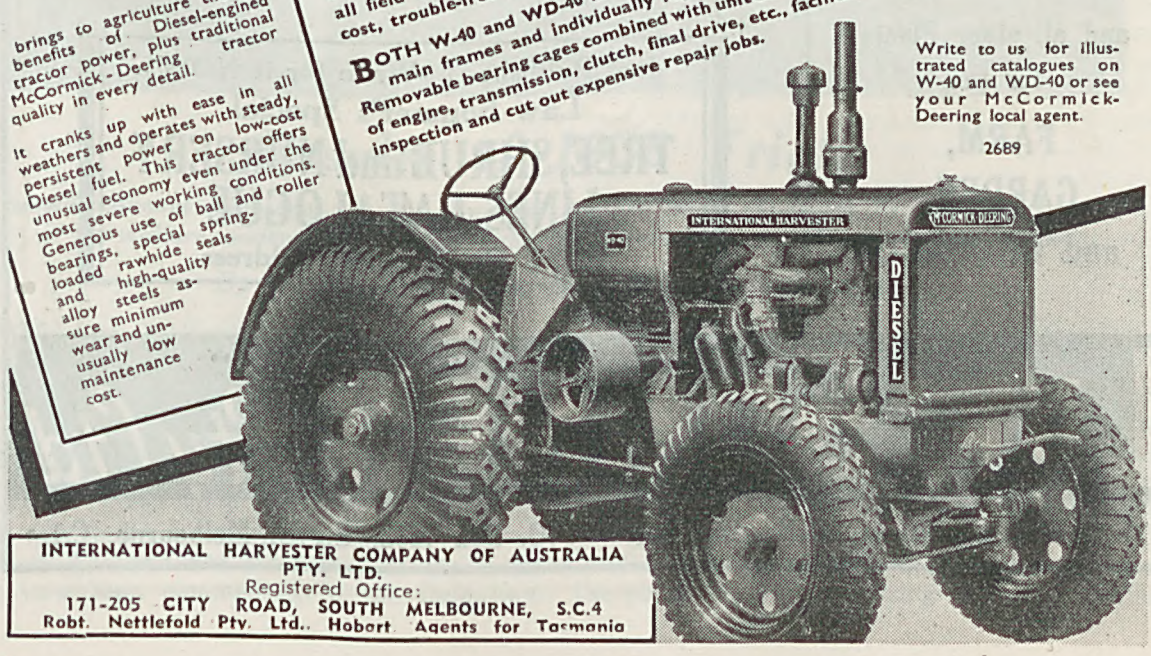

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The Journal of the DEPARTMENT of AGRICULTURE of VICTORIA

Journal of Agriculture, Victoria June, 1939.

Results of 1938 Trials

Seventh Annual Report of the Experimental Pasture Work conducted by the Department of Agriculture under arrangement with the Victorian Pasture Improvement League

By R. L. Twentyman, B.Agr.Sc., Agrostologist

THE pasture investigations conducted by the Department of Agriculture under arrangement with the Victorian Pasture Improvement League were commenced in 1932 to determine the best methods of improvement and maintenance of pastures throughout Victoria. In the early years the experimental work was confined to the dry land pastures of southern Victoria but extensions of the work have now been commenced in the irrigation districts of the north and on the dry land pastures of the north-eastern district.

Efforts have been made to improve pasture growth by means of fertilizer treatment, the introduction of improved pasture species, improved pasture management and by the adoption of the system of intensive rotational grazing.

Wherever practicable, measured records of the pasture growth resulting from the various

treatments have been made. On the manurial trial areas, the measurements are made by means of mowing and weighing the produce from the variously treated strips. Larger grazing areas were used for fertilizer trials in which differences in production were to be measured by means of grazing animals. Though this method failed to record yield differences which were quite apparent to the eye, the swards on these areas have served as a valuable check on the vigour and growth and botanical composition of the swards on the manurial mowing trials. The pilot plots and the sown pasture mixture and species trials were designed and have been used solely for observational purposes.

A full discussion of the object and purpose of the work was included in last year's report (see April, 1938, issue of this Journal), the experimental programme having been undertaken largely to ascertain the possibility of achieving in Victoria results similar to those which it was stated were being obtained in New Zealand. In this previous report, the soundness of the underlying principles was admitted, but the limited applicability of these methods under Victorian conditions was emphasized. The restricted value of these New Zealand practices under Victorian pasture conditions was further demonstrated in the past year owing to the unusually dry conditions experienced.

Improved soil fertility and the introduction of more vigorous species can do much towards increasing growth during those periods when soil moisture conditions are favorable, but as yet nothing short of irrigation has been of any use in promoting growth during the summer period when drought completely inhibits all growth. Pasture improvement, however, has done much to overcome the ill effects experienced during this period in that it has provided more nutritious dry feed for summer grazing. An examination of seasonal production growth curves readily shows how poor the autumn and winter growth usually is, but this can be improved by manurial treatment and the sowing of suitable species.

In normal summers neither manurial treatment nor drought resistant summer growing species are capable of producing any useful growth on most Victorian soils. Fortunately under the hot dry summer conditions, dry feed stands well and except for the lack of succulence the feed position is usually satisfactory during the summer. The autumn and winter periods are, however, much more uncertain and the only means of ensuring adequate feed during this period is by fodder conservation. The cutting and storing of surplus spring growth is necessary both to provide feed during periods of shortage and to prevent the opening up of the pasture sward.

SUMMARY OF RESULTS DURING 1938.

(Non-Irrigated Pastures.)

Manurial Trials.

The unusually severe drought experienced during the past year resulted in exceptionally poor pasture growth. Dry conditions in the autumn and winter delayed growth, and it was not until the early spring that any appreciable bulk of growth occurred. Unfortunately the spring rains failed completely and as a consequence there was no usual mid-season flush. The total effect of these conditions on the manurial trials has been that while the annual yields have been very low, the percentage increases, due to manurial treatment as shown by the records, have been unusually high.

A study of the manurial responses in previous years affords a ready explanation of this result. It is usual to find the greatest manurial responses in the early spring (August and September) while later on as growth becomes more vigorous, the differences between the manured and unmanured plots are very much smaller, the "no manure" plots yielding almost as well as the manured plots. In the past year the late heavy bulk of spring growth did not develop, and as a consequence the annual yields are composed of an unusually large proportion of growth made in the early spring, at which time the effect of the artificial fertilizers is most pronounced.

Generally, the manurial responses during the short period of early spring growth were of much the same order as is usual at this time, and this past year's results confirm the deductions drawn from the previous year's tests. Throughout the trials, it has been generally recorded that the lighter soils have been most readily affected by fertilizer treatment and it is again these light soils that have been the first to show signs of potash deficiency.

Last year's results confirmed this deduction, and an increased number of plots showing a potash deficiency has been recorded. No doubt

Showing the response obtained from the use of superphosphate on a Western District pasture plot.

this exhaustion has been accelerated by the repeated mowing and removal of the produce from the plots, but the results serve as a warning of the small margin of available potash present in Victorian soils, and suggest that care should be taken to guard against the extravagant use of the supply of soil potash.

Superphosphate.

Responses to superphosphate were spectacular during the first years of these trials, but the subsequent responses both on the mowing and on the grazing trials have not been so marked. The pilot plots were treated again last year with fertilizer after a spell of two years, and they responded unusually well during the spring. The trials have shown that superphosphate is, and will probably always be, the most important fertilizer for pasture purposes in Victoria, but the more recent results suggest that materials other than superphosphate may eventually be required. Such fertilizers would be required in addition to superphosphate rather than as a substitute for it.

During the past year the trials in the Colac and Cobden districts continued to show excellent response to the combined treatment of superphosphate and potash. Plots in these districts which have been treated with superphosphate for seven years in succession show a comparatively poor response to superphosphate alone, particularly on the plots that have been repeatedly mown, and the superphosphate and potash plots show up in marked contrast.

This potash deficiency was at first most marked on plots situated on pasture land which previously had been regularly top-dressed with superphosphate, but after repeated mowing and removal of the grass, responses to potash are now showing up on most centres. On dairy farms the bulk of the dung is deposited in the night paddocks or about the sheds, gate-ways, and cattle camps, and the greater part of the pasture receives little, if any, return of animal excrement at all. This is particularly the case where grass hay cutting is practised. With this treatment the grazed pastures should eventually suffer a potash deficiency similar to that experienced on the mowing areas and if such treatment is persisted in, fertilizer treatment involving more than superphosphate will be required. Neither the use of heavier dressings of superphosphate nor the addition of lime or nitrogeneous fertilizers has been

found to be effective when the soils have been "cropped out" in respect to potash.

In the first years of the improvement of most Victorian pastures, superphosphate is the only fertilizer of any importance, and, providing the pasture is properly managed and the remains of plants grown upon it are returned to the land in the form of dung, other fertilizers should not be required. Over-emphasis of the capabilities of superphosphate in the development of pastures and neglect of the most important matter of the natural return of nitrogen and potash to the soil can lead to rapid deterioration of the pasture. This effect has been deliberately accelerated on the mowing plots while the more normally treated grazing paddocks have been kept as a check on their behaviour.

Potash.

Again, during the past dry season good responses to potash were obtained. The total yields were usually not large, which indicates that the soil's ability to meet the current demands for potash were poor, and that the soils were still suffering the potash deficiency brought about by excessive "grass hay" cutting in the previous years. No new developments occurred in the potash responsive areas of the Western District, the results of the past year serving to confirm the results of previous years.

In Gippsland, however, some very marked responses to potash were obtained on plots which had not been responding well to superphosphate and on which it had been suspected that lime was the limiting factor.

At Larpent and Cobrico where the pasture swards have weakened very greatly after the repeated mowing, it was found that an annual dressing of 1 cwt. per acre of potash was sufficient to greatly increase the productivity of the pasture. This "basal" dressing of potash has been repeated during the past three years, and the areas so treated now stand out in marked contrast to those areas which receive the normal manuring treatment only, the latter having declined greatly in productivity.

On the newer Warragul plots, established on the properties of Messrs. Boardman, Teese, and Tyssen, mainly for the purpose of ascertaining the extent of the good lime response recorded on the older major plot, it has now been found that potash is of far greater importance than lime. Pastures suffering from a lack of potash usually show, an absence of clovers, poor harsh grass growth, and an excess of rib grass and flat weed (usually called dandelion). Usually the responsive soils are those which have been regarded as cropped out and which have been very slow in recovering when they have been allowed to spell in pasture.

Sulphate of Ammonia.

Nitrogeneous fertilizers showed a marked response in the early spring, particularly on the swards in which the clovers were sparse. On pastures which included a fair proportion of clover the response to sulphate of ammonia was small only and was followed by the usual depression caused by the suppression of the clover.

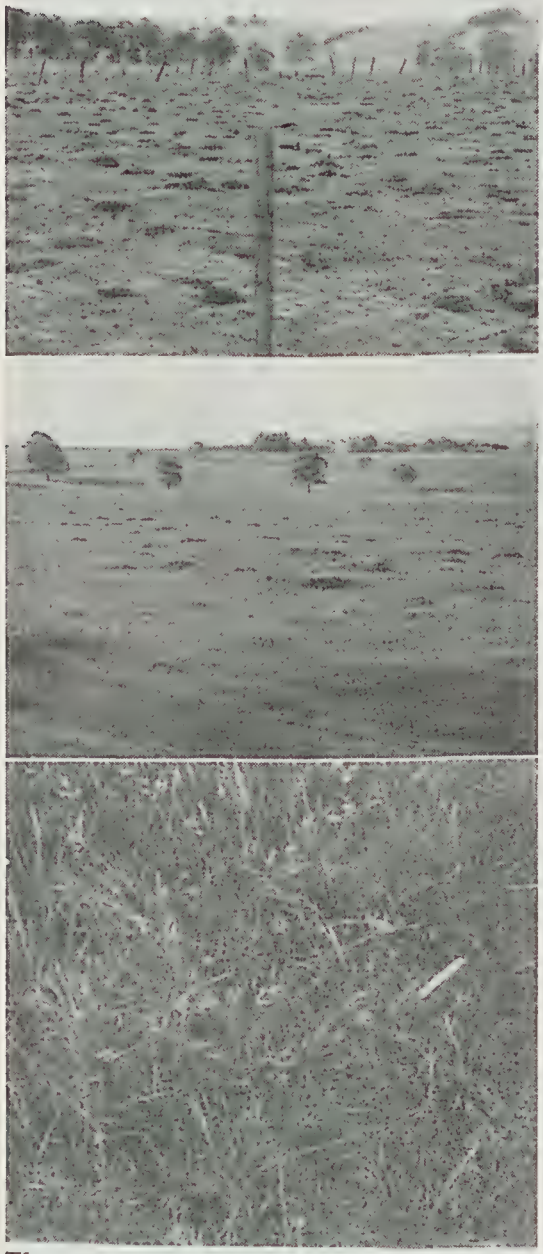
During the past year a good response was again obtained with sulphate of ammonia used in conjunction with superphosphate and lime on impoverished pasture land at Ellinbank. Where used with superphosphate alone on this trial the sulphate of ammonia did not effect much improvement, but used with both lime and superphosphate it gave an excellent response. Sulphate of ammonia has been applied both with superphosphate and with superphosphate and lime, to some strips on all major and pilot plots, but in most cases the response was poor and the addition of lime did not improve the growth as compared with superphosphate and sulphate of ammonia only.

From the results of the manurial trials it is evident that most Victorian soils are very deficient in nitrogen during the winter and this greatly limits pasture growth during this period. The stimulation of clover growth by the use of superphosphate and the return of the plant remains to the soil in the form of dung is the most practical method of overcoming this deficiency.

Lime.

Most of the plots have not shown any appreciable response to dressings of lime, but at North Mirboo and at certain areas in the Warragul and Kilmore districts, good results are still being obtained. Generally, the Western District has shown little or no response to this material, but during the past year plots receiving superphosphate, potash, and lime did show rather better responses than those receiving superphosphate and potash only. This no doubt was partly due to the small manurial differences which had shown to a small extent in previous years being greatly magnified during the past unusual season.

Trials incorporating different forms and brands and quantities of lime have been conducted on lime responsive soils. The conclusion reached as a result of these tests has been that, on soils responsive to lime, improvement in the pasture can be effected irrespective of the actual form or brand of lime and that dressings of 2 and 4 cwt. give a proportionately smaller response than do dressings of ½ and 1 ton per acre. On these lime-responsive pasture soils, either lime, or superphosphate alone, has usually given indifferent results and it is only when the two materials are used in conjunction that effective improvement is achieved.



The cause, symptoms and result of the neglect of pasture harrowing. Top.—A heavy accumulation of droppings on dairy land. Centre—Rank patches showing on pasture in early spring due to unspread droppings. Bottom—Showing strong development of Yorkshire fog grass which has become established on an old dung pad.

In the Warragul district somewhat conflicting results have been obtained with lime and though it appears to be of value on some land, there are large areas of better pastures which evidently do not require it. Again, as with potash, this effect appears to be related more to previous treatment of the soil than to its structure and origin.

Rock Phosphate and Blood and Bone.

Tests with rock phosphate and blood and bone have been continued, but while they have shown some value for top-dressing pasture land, the economic return from them is much inferior to that obtained from superphosphate.

Pasture Mixtures and Strains Trials.

The pasture mixtures and strains trials have been subjected to very severe conditions during the past year and their growth has been much less than usual. In the early part of the season the germination of the clovers was hampered by the dry weather and the perennial grass species received an advantage, but later in the year this was compensated for by the clovers receiving encouragement on account of the short pasture growth. The dry autumn emphasized the weakness of encouraging too great a proportion of annual species in the pasture. In some cases where the "pastures" had consisted mainly of subterranean clover, no growth at all was made before the winter, and it was very obvious that an admixture of perennial rye, phalaris, or danthonia was most desirable. Such grasses did make some growth with the very meagre rains while the subterranean clover in the absence of soaking rains was completely dormant.

In the drier northern areas the recent hot dry summers proved rather too severe for the perennial rye-grass and demonstrated the better drought resistant qualities of *Phalaris tuberosa*. Encouraged by good results with top-dressing and placing rather too great a reliance on the ability of the superior strains.

A strong sward of **Phalaris tuberosa** *in the North East.*

to persist under unfavorable climatic conditions, considerable areas of perennial rye-grass had been established in places which had previously been regarded as unsuitable. The recent severe summers proved too much for the perennial rye and showed that its life in these areas is dependent on favorable weather, and that it is unable to survive the hot summers so frequently experienced. Although phalaris has proved much more drought resistant under these conditions, it must be recognized that permanent perennial pastures cannot be indiscriminately established throughout areas primarily best suited to cropping.

In the southern districts also the perennial rye-grass has suffered from the very severe summer. Heavy rains, which fell at the end of February, in Gippsland and the North-east, relieved the position, but the Western District did not receive this rain and has experienced one of the driest periods on record. As a consequence it appears that many of the rye-grass pastures sown on the marginal soil types will be severely thinned out. The full extent of this damage will not be apparent until after the rains occur, but it is already evident that considerable damage has been done, and that an increase in the weed population of the damaged pastures can be expected.

Phalaris, though capable of surviving prolonged dry periods, was not able to make any appreciable growth during the past summer nor during the previous dry autumn and winter. Paspalum behaved similarly during the dry period, and with brown top, Chewing's fescue, and Kentucky blue demonstrated how thoroughly persistent grasses can remain almost completely unproductive. In Gippsland, paspalum has made an excellent recovery since the rain, but other species ordinarily capable of summer growth such as white clover, red clover, and kikuyu grass, weakened by the severe dry summer, have made only a belated recovery.

Weather Conditions During 1938.

As has been frequently referred to previously, the past season was one of exceptional drought, and combined with the very dry season of 1937, it has been, over most of Victoria, the driest and most severe period on record. The south and far Western District escaped the dry conditions until the mid-spring, but the remainder of the State produced very little growth for the whole of 1938.

The autumn and winter of 1938 were very dry and operations on pastures were delayed pending the arrival of the rains.

[*Continued on page* 285.

Irrigation at Kerang

Permanent Pasture of Annual Species Competition, 1938-39

Report of Judge, E. T. Beruldsen, B.Sc. (Agric.), Senior Irrigation Officer

IN this report, which is complementary to that published in the May issue of this *Journal*, a tribute must again be paid to subterranean clover, Wimmera rye-grass, and superphosphate for giving the biggest impetus to pasture improvement in the Kerang district during recent years. The first ventures in the establishment of this type of permanent pasture soon demonstrated the wonderful possibilities of rehabilitating large areas previously neglected except for spasmodic production of oat crops or summer fodder crops.

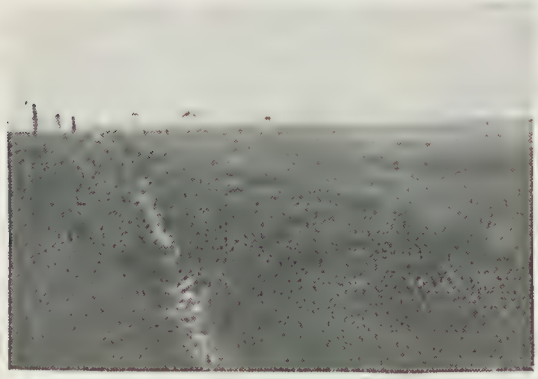
The relative cheapness of establishment and the low maintenance costs were very attractive in view of the tremendous increase in carrying capacity involved. Since, compared with lucerne or pastures of perennial species, few irrigations only were required to maintain green feed for eight to nine months in the year, there was less risk of permanent injury if the grading was not perfect; and during the course of the inspections carried out during this competition one found that in the earlier established pasture paddocks the grading was almost crude.

Happily, the more recent efforts in the establishment of these pastures indicated a better appreciation of the advantages involved in having a more even distribution of the irrigation water. This was shown in the more refined methods of lay-out. The resultant economy in watering has produced better and more uniform pasture swards. In extreme cases where cruder methods of lay-out exist, large quantities of water have to be drained off after the completion of each irrigation, since unduly large banks and a large volume of water are required in an endeavour to irrigate the high spots.

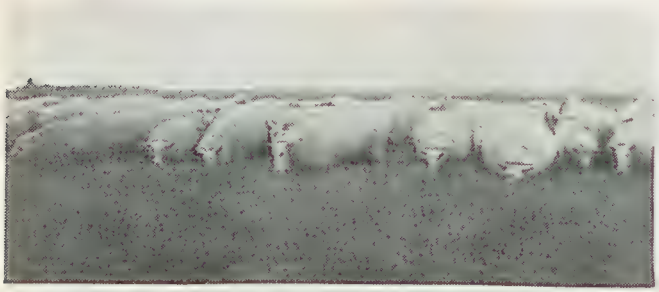
Portion of Mr. G. R. Morton's excellent winning pasture.

One of the outstanding features of this pasture type in conjunction with top-dressing has been its capacity to regenerate and raise the fertility level of the poorer classes of soil. This pasture now occupies large areas in the district which formerly were what is known locally as "wind swept plain". In this class of country, before the advent of subterranean clover and superphosphate, through consistent over-grazing the wind had almost completely denuded large patches of soil, leaving in extreme cases the rather impenetrable clay sub-soil exposed. In the first instance the surface was stiff clay loam only a few inches in depth. The too frequent removal by stock of the sparse native vegetation has facilitated wind erosion.

A wonderful example of the regeneration of this type of country was noted on the property of Messrs. Wilkinson and McDonald (Summer Hill), adjacent to the Murray Valley highway near Kerang. This was ploughed, graded, and sown



An effective drainage channel for removing surplus water on Mr. G. R. Morton's property.



Some of Mr. Morton's fine Border Leicesters and cross-bred weaners.

with 6 lb. Wimmera rye-grass and 4 lb. subterranean clover in the autumn of 1933. One bag of superphosphate per acre has been applied in the late summer each year.

Although not very uniform the sward is excellent in patches, and the poorer patches appear to be improving. In late spring, great care is exercised not to graze the pasture too severely, and a cover of dry grass, &c., remains throughout the midsummer. This affords excellent cover for the development of young seedlings in the autumn, and there is no doubt that this wise policy has contributed very largely to the success of this pasture. A conservative estimate would be that the paddock now carries ten times the number of stock which it carried prior to 1933. This policy has been of particular benefit during the past two seasons which, on account of their abnormal dryness, generally have reacted unfavorably on the development of pastures of this type. Many farmers have been disappointed by the diminution in the proportion of subterranean clover in their pastures during the last two seasons, and this effect is probably due to attempting to carry the same number of stock in the late spring on these pastures as they would in normal seasons.

There is a definite tendency to be more liberal in the matter of top-dressing with superphosphate than in past years. Although subterranean clover is recognized to be a relatively low-fertility-demanding species, marked benefit has been demonstrated under irrigation conditions when the annual dressing has been increased from 1 cwt. to 1 bag per acre. Most of the competitors had adopted one bag per acre as the standard dressing, and the response of the legume constituent has been remarkable in consequence.

Up to the present, with few exceptions, irrigation farmers have regarded Wimmera rye-grass and subterranean clover purely as a grazing medium, and their possibilities as a medium for fodder conservation have been overlooked. With little or no subdivision of areas improved in this way it is impossible to conserve a portion of the pasture for hay. Too often the method of stocking is to put a certain number of cattle or sheep into a paddock and leave them there to graze at will.

Frequently one hears the boast that so many cattle or sheep were turned into the paddock, were there all winter and spring, and could not keep the feed down. This statement is intended to, and does to a degree, extol the virtue of a certain paddock, but also it reflects on the management of the paddock by the owner. Naturally, where the stock are permitted to graze a paddock with little or no respite, there is danger of overgrazing in patches while other patches are allowed to grow rank. The rank patches represent so much waste. A better system of grazing management involving rotational grazing can be achieved by the most simple subdivision. Even if the area be divided into two, a great advance has been made. Surplus growth in spring can be conserved as hay, and this type of hay has excellent fodder value and is very palatable. Indeed, less wastage has been noted in the feeding out of this hay than in feeding out lucerne hay. The density of the material is responsible for surprisingly high yields.

Two main objections to conserving pasture hay are encountered frequently. One is that this type of hay is too difficult to handle, and the other is that it has little saleable value. The answer to the first objection is that by the use of sweeps in the paddock and a tall pole and pulley block and slings at the stack, large quantities of hay can be handled in a relatively short period. Many of these aids to fodder conservation can be constructed on the farm at relatively small cost.

Regarding the second objection, the aim of fodder conservation is defeated to a large extent if any large proportion of the reserves is sold off the farm. When fed out on the farm, a great deal of the mineral content is returned to the soil, while if sold, as in the case of milk, lamb, &c., so much is completely removed. As to the sale value, seasons such as have been experienced lately have given the graziers outside the irrigation areas a better appreciation of the value of pasture hay, and in the happy event of a farmer having a large surplus in future there should not be much difficulty in disposing of it at a remunerative figure in a period of scarcity.

While a certain proportion of inferior annual grasses and weeds is unavoidable in a Wimmera

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rye-grass–subterranean clover type of pasture, too much barley grass and weeds was noted in most cases. Further, there was a tendency for some of the pastures to have too high a proportion of clover, the rye-grass being suppressed. It has been demonstrated that harrowing or light cultivation of the pasture sward in late summer, before rain or irrigation induces germination, will regenerate the rye-grass and at the same time diminish the proportion of grasses, such as barley grass, and of weeds. It is known that in extreme cases, pastures of this type have been ploughed at this period of the year without having caused any permanent injury to the establishment of the clover or the rye-grass.

Baled Wimmera rye and subterranean clover hay. (Mr. G. R. Morton.)

The Awards.

Mr. G. R. Morton, of Benjeroop, had the distinction of gaining both first and second places in the permanent pasture of annual species section of the competition with two exhibits of exceptional merit. On his farm of 500 acres, mostly lignum country, Mr. Morton has gone in for subterranean clover and Wimmera rye-grass in a big way. To date he has improved and sown down 260 acres of his property. Of this, 30 acres are in lucerne, 20 acres in pasture of perennial species, and the rest in pasture of subterranean clover and rye-grass. Quite a large proportion of the farm still has to be cleared. About 1,000 ewes and some carry-over lambs are carried. Recently nearly 1,200 sheep were crutched on the property. In addition, a few cattle and six horses are kept. About 800 lambs are reared each year.

Abundant fodder reserves are stacked each year, and most of this hay is fed out to the ewes, even when green pasture feed is abundant. This has the effect of correcting the balance of the ration, and the good health of the sheep is assured.

Stacking Grass Hay.

Mr. Morton has had the unique experience of being able to sell a considerable quantity of his rye-grass-subterranean clover hay, and the accompanying photograph shows the bales of hay loaded on to motor trucks. The hay is collected in the wind-row with the aid of a sweep, and transported to the stack, where with the aid of home-made slings and a home-made crane operated by a horse, it is put into the stack rapidly and efficiently.

Mr. Morton attributes the relative freedom from weeds and inferior grasses in his prize paddocks to cultivation in the late summer and to the suppressing effect of the wonderful development of clover and rye-grass.

The winning pasture was sown with a light seeding of barley in the autumn of 1933, 2 lb. subterranean clover and 3 lb. Wimmera rye-grass being used per acre. No manure was applied the first year, but 1 cwt. per acre was applied in the following year. In the last three years one bag per acre has been applied each autumn. Mr. Morton has cultivated the paddock twice in recent years, and had intended to repeat the cultivation this season, but the late summer rain prevented this, since the clover and grass had germinated before cultivation could be carried out. These cultivations have improved the uniformity of seeding of the paddock in addition to suppressing weeds. This 7½-acre paddock was a beautiful sight with its dense, even growth of a well balanced mixture. Mr. Morton estimates that it has carried five ewes and their lambs per acre. Both at the spring and autumn inspections the condition of the pasture left nothing to be desired. At the

autumn inspection it was hard to believe that only three weeks previously 450 ewes had been on the paddock for three days.

Exhibit B was a recently established paddock, first sown in May, 1937. Despite the adverse seasons it had developed remarkably well. Certified Tallarook subteranean clover—2 lb. per acre—was sown with a sprinkling of Wimmera rye-grass and perennial rye-grass. Afraid that the paddock had been inadequately seeded, in the autumn of last year Mr. Morton scarified and sowed a further 1½ lb. of Tallarook clover (uncertified) and some screenings of Wimmera rye-grass obtained from the thresher. The paddock was in very good condition at both inspections. At the second inspection it contained more weeds than Exhibit A. It was very interesting to note on this heavy soil type how the perennial rye-grass plants established in 1937 had lived through two summers without irrigation.

Mr. H. C. Murray's pasture was sown in the autumn of 1935 with half a bushel of oats, 20 lb. Wimmera rye-grass, and 4 lb. of subterranean clover. One bag of manure per acre was used at seeding and one bag per acre has been applied since. Although difficult to grade, this 15-acre paddock had been well laid out for irrigation.

At both inspections the paddock was being grazed, but despite this the pasture looked in very good condition, and there was a good balance of grass and clover. During the 1938 season, from the middle of April to the beginning of November, this paddock had supported 40 milkers for periods of ten days to a fortnight with intervals of three weeks between these periods.

Mr. Hall's pasture was also of a high standard, and reflected good methods. Generally, all the exhibits were good examples of the progress made in pasture improvement in this district during the last few years, and very keen competition must be expected in future.

PERMANENT PASTURE OF ANNUAL SPECIES AWARDS—KERANG.

Competitor.	Lay-out for Irrigation and Condition of Channels.	Condition.	Uniformity.	Mixture.	Freedom from Weeds.	Total.	Grand Total.
Possible Points	(20)	(20)	(20)	(20)	(20)	(100)	(200)
1. G. R. Morton (Exhibit A)	16	20	19	19	18	92	187
	17	20	19	20	19	95	
2. G. R. Morton (Exhibit B)	16	18	19	18	19	90	179
	16	19	18	18	18	89	
3. H. C. Murray ..	18	17	17	18	17	87	175
	18	18	17	17	18	88	
4. G. Hall	16	19	17	17	17	86	174
	16	20	17	17	18	88	
5. Wilkinson & McDonald (Exhibit 2)	18	15	18	18	16	85	172
	18	18	17	17	17	87	
6. Wilkinson & McDonald (Exhibit 1)	17	17	17	16	15	82	167
	17	19	16	17	16	85	
7. C. H. McDonald ..	15	16	17	17	18	83	167
	15	18	16	17	18	84	
8. Shepard Bros. ..	16	16	15	16	15	78	160
	16	17	16	17	16	82	

Judging November, 1938, and May, 1939. Results of November inspection given first in each case.

Tomato Culture

By Basil P. Krone, Fruit Packing Instructor

[Previous articles on suitable soils, sowing of seed, hot-bed and cold frame, planting out, irrigation, &c. in connexion with tomato growing, appeared in the February and April issues of this Journal.]

Manures.

The fertilization of soil for tomato plants is sometimes a vexed problem. There is no known substance that will improve a soil better than natural animal manures. They not only supply the various plant foods, but improve its physical condition by the addition of humus, resulting in better aeration and improved moisture holding capacity. Stable manure might be termed the ideal complete fertilizer. Of course stable manure is not always available in sufficient quantities, and then artificial fertilizers have to be used. If their use is not thoroughly understood by the grower, the maximum results will not be obtained.

The experienced farmer knows that *well decomposed* stable manure can be applied safely to any soil; in fact, there is scarcely a soil-type that it will not benefit. Unfortunately, the same remarks cannot be applied to the indiscriminate use of artificial fertilizers, and these good results are not always possible on some soils with certain of these fertilizers.

The chief artificial fertilizers used for general farming are superphosphates—supplying phosphoric acid; sulphate of ammonia or nitrate of soda—supplying nitrogen, and sulphate or muriate of potash—supplying potash. When these fertilizers are applied in combination, such as, for example, the 2 : 2 : 1 mixture, they are also known as a complete fertilizer, viz., 2 parts of super., 2 parts of sulphate of ammonia, and 1 part of potash, but there is a difference in the results obtained when each of these types of complete fertilizers are compared in the field.

What is this difference? It is simply this: We are apt to forget about the humus which is lacking in artificial fertilizers. Applications of 8 to 12 cwt. per acre of 2 : 2 : 1 mixture might be used with excellent results on soils well supplied with organic matter, but where this is deficient, humus must be included in the form of cover-crops or supplied from other sources. Artificial fertilizers without humus may be likened to a person taking a tonic, without food in which "bulk" is so necessary to maintain health.

Mac's Special tomatoes grown in the bush form at Portland.

6157/39.—3

Frequently, artificial fertilizers are not applied deeply or early enough. Most fertilizers should be applied at least three weeks before planting, and placed deeply enough to be within the root zone of the plants.

Blood and bone, superphosphate and potash are the chief artificial fertilizers for tomatoes. Heavy applications of quick-acting nitrogenous fertilizers, such as sulphate of ammonia or nitrate of soda, cause splitting or softening of the fruit of some varieties of tomatoes. There are, of course, occasions when the application of one or more of the latter ingredients as a side dressing would be warranted.

For general purposes, the following suggestions may be useful:—Mix together six parts superphosphate, four parts blood and bone or abattoir manure, and one part of potash. Use a double handful of this mixture for each six or eight little plants at least three weeks before planting time. On some types of soil the proportions of blood and bone, and superphosphate given above may be interchanged with excellent results, also in some districts potash may be eliminated because there are large amounts of available potash already in the soil.

In the Goulburn Valley applications of gypsum, at the rate of at least 2 tons per acre, frequently give very good results owing to the improvement brought about in the physical condition of the soil. It is possible that it also makes available portion of the abundant supply of potash present in these soils. Again, sulphate of ammonia or nitrate of soda would be more useful on light sandy or gravelly soils, e.g., around Pomonal and also in parts of the Portland district. If the soil is inclined to be alkaline, sulphate of ammonia should be used, as it tends to make the soil more acid. Blood and bone, abattoir manure, castor meal, and cover crops should not be overlooked in the fertilizer programme, especially in the light sandy soils or loams deficient in organic matter.

Fertilizers should be thoroughly mixed with the soil or placed beneath the plant in such a manner that they will not come in direct contact with the roots. This can be most easily achieved when "hilling" up the lands, which usually consist of four furrows, by casting the required amount of fertilizer along the bottom of the third furrow and stirring it in the lower soil before the fourth furrow is thrown on top of it. The plants are later planted over this furrow. For wider plantings in non-irrigable districts the appropriate planting furrow should be used instead of the third one.

Another method is to drill the fertilizer in at the rate of 8 to 12 cwt. per acre over the whole area a few weeks before planting. If a side dressing of a quick-acting nitrogenous fertilizer is to be used, it can be applied after the first set of fruit has formed by watering it in with an irrigation, taking care not to let it come in direct contact with the leaves or plant. A mixture of from six to three parts of superphosphate, according to district, and one part sulphate of ammonia, is recommended for the purpose, and generally gives excellent results.

Superphosphate usually gives good results when applied to tomatoes, but in some districts it does not, therefore, in such instances the quantity of superphosphate should be decreased and the quantity of blood and bone increased. The 2 : 2 : 1 mixture, previously referred to, also gives good results, and where one is not certain which manure to use, money would be more wisely spent on this complete mixture than by taking a chance with any single fertilizer.

Lime is seldom necessary in tomato culture. Soils showing pH reactions of 6.5 to 7.0 would appear to be the best for tomatoes, but good crops frequently are produced on soils which are more acid or less acid than this range. One of the best uses for lime in tomato culture is its application on the land prior to sowing a cover crop. It has a special influence in the growth of peas and other legumes. Cover crops improve the physical condition of the soil and thus, indirectly, improve the growth of the tomato plant.

If fertilizers (and lime) are to be used singly, it is recommended that they be applied as follows:—

Lime.—Although not a fertilizer, should be applied in the autumn.

Blood and Bone or Abattoir Manure.—In the very early spring, or a couple of months before planting out.

Sulphate of Potash.—A month before planting.

Superphosphate.—A week before planting, at planting time, or with ammonia as a side-dressing.

Sulphate of Ammonia or Nitrate Soda.—As a side-dressing after planting, and as soon as the first fruit has set. An excellent method with this fertilizer is to water it in.

Tying up and pruning tomatoes at Portland.

Pruning.

Pruning the tomato plant is really a simple procedure. By careful observation, almost any one could carry out the necessary work in a satisfactory manner, but the nature of the numerous varieties should be first understood so that they may be treated according to their respective habits. To do this, tomatoes should be classified into three groups, namely:—

Chinese or Crinkled Types.—These include the rough, flat, crinkled, or corrugated varieties such as Australian Large Red, Burwood Wonder, &c. Such varieties are noted for their good cropping habits, suitability to most soils and locations, and marketable size of the fruit without pruning. Chinese types, unfortunately, are not noted for high quality fruit, nevertheless, they serve a useful purpose. They should be grown in the bush form and unpruned, except in glasshouses, or in the home garden, when pruning to one or two leaders, on stakes, is advised. Economics are the deciding factor for pruning. For home garden purposes, the plants are better when kept off the ground by staking. They are also more readily accessible for cultivation, &c.

Smooth Globe or Canning Types.—These varieties are not usually such heavy croppers as the Chinese kinds. Indeed, some are particularly shy, and vary in their preference to soils and location. Some, however, are entirely satisfactory, and should be grown without pruning and in the bush form, while others are better when pruned heavily to a single leader on stakes. Others, again, are more satisfactory when two or more leaders are adopted. Some varieties in this group are noted for the outstanding colour and quality of the flesh for factory purposes and for the table. To the enthusiastic home gardener, they are a delight to grow. An increased number of good cropping varieties is being established each year.

Dessert or Cluster Types.—Varieties in this group are by far the heaviest croppers. They

That some varities respond to pruning and staking more than others is evidenced by this plot of tomatoes at Portland. Some of the lower foliage had been removed to hasten the ripening process of this enormous crop.

are so prolific that, if left unpruned, they will produce fruit as small as marbles, therefore, it is important that these should receive special treatment. The cluster types are not satisfactory unless heavily pruned to a single leader and staked, and the clusters of fruit thinned as soon as possible after the sets have formed. To do this, the terminal fruits should be discarded, retaining those nearest to the main arm. The soil should be heavily impregnated with very old cow or sheep manure, and in addition, the plants should be side-dressed with artificial fertilizers.

From the above, it is readily seen that it serves no useful purpose to prune some varieties too heavily, as the fruit reaches normal size with ordinary methods of good tomato husbandry.

Method of pruning tomatoes.

Pruning consists of pinching out the laterals and retaining 1, 2, or 3, leaders according to the recommendations. A denotes where the lateral growths should be pinched out and B the flower "sets" or fruit. When the plant reaches the top of the stake, pruning can be discontinued.—If early varieties are grown and early fruit required, the top of the plant should be pinched back about the height of the top of the stake.

Pruning consists of pinching out the lateral growths as soon as they appear in the axils of the leaves. This practice should be modified according to requirements of the variety and habit of the plant. At the same time, it should be observed that the "sets" of flowers do not emerge from the base of the leaf stems, such growths are new laterals coming into existence, and these frequently confuse the beginner. The first set of flowers emerges directly from the main arm, usually midway between the tenth and eleventh leaf. In calculating this, allowance should be made for the early leaves, which frequently fall after planting-out time. The second set of flowers emerges likewise, but between the following fifth and sixth. Each successive set of flowers then emerges after each succeeding third leaf during the life of the plant.

If the laterals are allowed to develop, they also grow into main arms, and sets of flowers are produced on each of them in a similar manner to that described, except that they appear after every third leaf from the base of the lateral. With this in mind, and the knowledge that one variety may be of the small dessert or cluster type, and another a larger canning variety, the grower can modify his pruning accordingly.

There are, of course, varieties which are exceptions to the foregoing statement, therefore, to avoid confusion, tests have been made, and a list of varieties of "Tomatoes of Outstanding Merit in Victoria, and How to Grow Them," is published elsewhere in this article. The reader is advised to note the recommendations before commencing to prune. Many disappointments have occurred in Victoria through the misapplication of staking and pruning, with the result that some good varieties, especially the cluster and canning types, have been unjustly condemned.

Pruning tests have shown that it does not pay to prune unstaked plants to encourage early maturity of the fruit. If varieties are to be pruned, it is better to stake them, disbud the laterals according to requirements, and stop the main leader after the third or fourth set, or when the plant reaches the top of the stake. Any yellow leaves that appear should be cut off and burnt.

Eccles Surprise tomatoes pruned to four and five leaders on stakes.

Tomatoes of Outstanding Merit in Victoria and How to Grow them

Group No. 1.—Recommended Chinese or the Flat Corrugated Types.

Note :—The Chinese or flat corrugated types of tomato usually form the main crop in Victoria. They are consistently heavy croppers; produce fruit of good marketable size without pruning or staking, but unfortunately, the quality is inferior to the canning types. These Chinese types also produce a larger percentage of badly misshapen fruits than do the other types, and are useful for pulping only. Although all the varieties in this list can be recommended, careful observation has shown that the first three will give greater satisfaction than the others, if the following recommendations are noted :—**Bendigo Large Red** is satisfactory throughout the State. **Burwood Wonder** and **South Australian Dwarf,** which are of the same type, are especially suited to the Goulburn Valley and northern irrigation districts, although they are satisfactory in many other places. They can also be used as an early variety. **Orange Prolific** is most suitable for southern Victoria and is essentially a late variety. Although ripening periods have been found to vary in different parts of the State, those described apply more particularly to southern Victoria, but they will also serve as a guide for most districts.

Variety.	Approx. Percentage of Solids Ratio.	Approx. Period of Seed to Maturity.	Average Size of Fruit.	Suggested Method of Growing.
		Days.	Diameter in Inches.	
Bendigo Large Red (1)	3.6	148	2-3½	Unpruned and in the bush form
Burwood Wonder (2)	3.6	140	2-3¼	
South Australian Dwarf*	3.6	140	2-3¼	
Orange Prolific (3)*	..	..	2-3¼	
Portland Mortgage Lifter	3.6	154	2 3¼	
Mac's Special (a Portland variety) ..	3.5	148	2-3¼	
Pale Leaf (syn. with Yellowtop) ..	3.6	146	2-3¼	

* These varieties are particularly suited for glass-house culture.

Numbers 1, 2, and 3 indicate varieties which may give greater satisfaction than the others.

Varieties showing a low percentage of solids are not the best for canning purposes. Compare Group No. 2. The high acid ratio of some of the crinkled varieties is also a disadvantage. Their chief virtue is a good cropping habit. Each grower should produce a small percentage of a good canning variety each season. **Red Marhio** is recommended for this purpose. If this is not convenient, a few plants or seeds mixed through the main crop will greatly assist in improving the present strain by interpollination.

Group No. 2.—The Large, Smooth, Round Varieties recommended for Canning Purposes.

Note:—This class of tomato has only a medium cropping habit. The fruit is either a smooth round flat shape or a smooth globe shape. Good commercial size and quality.

Variety.	Approx. Percentage of Solids Ratio.	Approx. Period of Seed to Maturity.	Average Size of Fruit.	Suggested Method of Growing.
		Days.	Diameter in Inches.	
Red Marhio	6·5	153	2–2¾	Bush form, but preferably lightly pruned on stakes
Eccles Surprise*	5·2	158	2½–3½	,, ,, ,, ,, ,,
Low Branch	6·8	153	2–2¾	,, ,, ,, ,, ,,
Scarlet Dawn	7·0	138	2–3	,, ,, ,, ,, ,,
Bone's John Baer	4·8	145	2–3	,, ,, ,, ,, ,,
Crimson Bell	4·8	Early	2–3	Bush form in districts such as Bacchus Marsh and Bairnsdale

* Lacking in colour for canning purposes.

Group No. 3.—Recommended Dessert or the Small Cluster Type.

Note:—Caution is necessary in selecting these cluster types. They are smaller fruiting varieties than the others and, therefore, *not suitable as a main crop*; they are table or home garden varieties useful for staking and, in some instances, for glass-house culture. This class of tomato is an exceedingly heavy cropper and will produce fruit like marbles unless treated according to the recommendations. The fruit is mostly of a smooth, round shape, and inclined to run small. **San Marzano,** an elongated variety, being somewhat dry and mealy serves a special purpose as a sauce and chutney variety.

Variety.	Approx. Percentage of Solids Ratio.	Approx. Period of Seed to Maturity.	Average Size of Fruit.	Suggested Method of Growing.
		Days.	Diameter in Inches.	
Walker's Recruit (1)	4·0	146	1¾–2½	Heavily pruned; heavily manured; shorten the clusters; single leader on stakes
Portland's Sensation (2)	3·8	..	2 –2¾	,, ,, ,, ,, ,,
Potentate (3)	4·0	146	2 –2¾	,, ,, ,, ,, ,,
Kondine Red*	3·8	144	1½–2¼	,, ,, ,, ,, ,,
Heterosis	3·8	152	1¾–2½	,, ,, ,, ,, ,,
Market King*	3·8	145	1½–2¼	,, ,, ,, ,, ,,
San Marzano	6·8	146	Like a large chili	The whole bush tied up on stakes; not pruned

* These varieties are suitable for glass-house culture, but may not prove so profitable as the **South Australian Dwarf** which is shown in Group No. 1.

Numbers 1, 2, and 3 indicate varieties likely to give the best results if grown for marketing purposes.

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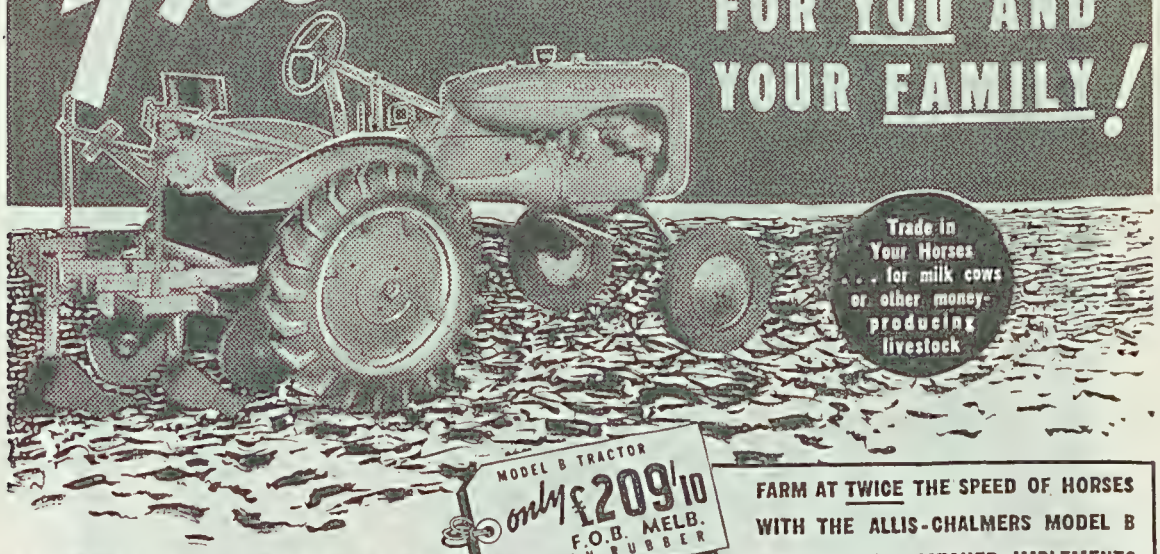

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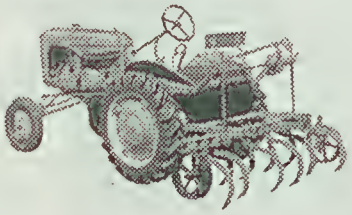

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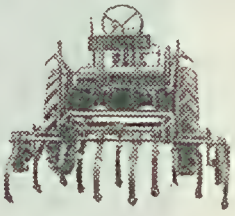

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Some Dessert or Cluster Types tested in 1937-38.

The dessert or cluster types tested in 1937–38 are mostly table varieties, unsuitable for canning. Some are special sauce varieties and unsuitable for the table. All are unsatisfactory unless staked and heavily pruned to a single leader. **San Marzano** is an exception; this variety should be staked but not pruned. Varieties recommended for adoption are shown on another page.

Variety.	Period of Seed to Maturity.	Habit of Plant.	Cropping Ability.	Average Size of Fruit.	Quality and Flavour.	Remarks.
	Days.					
Principe Borghesi ..	143	Tall	Heavy	Size and shape of pullet's egg	Good	Sauce variety. Uneven ripening habit; not as good as San Marzano. Not a table variety
San Marzano ..	146	Medium	,,	Like a large chili Inches.	,,	Probably the best variety known for sauce. Not a table variety
Kondine Red ..	144	Tall	,,	1½–2¼	,,	Excellent table variety; smooth round bright red
Market King ..	145	,,	,,	1½–2¼	,,	Smooth, round table variety
Maori Chief ..	145	Medium	,,	2 –2½	Fair	Smooth, round, slightly flattened table variety
Sutton's Best of All	145	,,	,,	1½–2¼	,,	,, ,, ,, ,, ,,
Recruit (Bide's) ..	146	Tall	,,	1½–2¼	,,	,, ,, ,, ,, ,,
Radio	..	Medium	,,	1¾–2½	,,	,, ,, ,, ,, ,,
Heterosis	152	Tall	,,	2 –2½	,,	,, ,, ,, ,, ,,
Potentate	146	,,	,,	2 –2¾	,,	,, ,, ,, ,, ,,
Carrie	140	Medium	,,	1¾–2½	,,	,, ,, ,, ,, ,,
Excelsior	..	Tall	,,	1½–2¼	,,	Smooth, round table variety
Early Sunrise ..	..	,,	,,	1½–2¼	Good	,, ,, ,, ,,

Special Note:—Few cluster types are satisfactory unless heavily pruned and staked to a single leader. The clusters of fruit should be thinned as soon as possible after they have set. The plant should be stopped after the fourth or fifth "set" and the soil heavily impregnated with very old cow or sheep manure. In some instances, additional dressings, with artificial fertilizer, should be given.

Germination and Ripening Periods of some Tomato Varieties and Certain Results from Disinfected Seed.

The following variations in the germinating periods were obtained by using disinfected and non-disinfected seed. Before saving tomato seed the reader is advised to carefully note the recommendations for disinfecting the seed described elsewhere under the heading of "Saving Tomato Seed."

Note:—All seed sown on 1st August.

Variety.	Germinated.	Pricked Out.	Planted Out.	First Ripe Fruit.	Period of Seed to Maturity.	Approx. Percentage of Solids Ratio.	Remarks.
	Aug.	Aug.	Sept.	Jan.	Days.		
Kondine Red ..	11	18	18	2	144	3·8	Seed not disinfected
Bone's John Baer ..	11	18	18	3	145	4·8	,, ,, ,,
Mac's Special ..	11	18	18	6	148	3·5	,, ,, ,,
Maori Chief ..	11	18	18	3	145	3·2	,, ,, ,,
Heterosis	20	27	27	26	159	3·8	Germination delayed approx. 10 days through seed disinfected 1 in 1,000 mercuric chloride
Low Branch ..	20	27	27	27	160	6·8	,, ,, ,, ...
Red Marhio ..	20	27	27	27	160	6·5	,, ,, ,, ,, ,,
Eccles Surprise ..	20	27	27	Feb. 1	165	5·2	,, ,, ,, ,, ..
Sutton's Best of All	11	18	18	Jan. 3	145	3·6	Seed disinfected 1 in 3,000 mercuric chloride. Germination not retarded
Coronation ..	11	18	18	10	152	3·8	,, ,, ,, ,, ,,
Burwood Wonder ..	11	18	18	Dec. 29	140	3·6	,, ,, ,, ,, ,,

Tests with some Special Canning Varieties received from U.S.A.

While all the following varieties are of excellent red colour, not watery, non-acid, and excellent for canning or transport purposes, it would be misleading to recommend them for main crop plantings. They are not superior to **Red Marhio, Low Branch,** and **Eccles Surprise,** the seeds and young plants of which are now stocked by some of the local seedsmen and florists.

Variety.	Seed Sown.	Germinated. *	Pricked Out.	Planted Out.	First Ripe Fruit.	Period of Seed to Maturity.	Approx. Percentage of Solids Ratio.	Remarks.
	Sept.	Sept.	Oct.	Nov.	Jan.	Days.		
Early Shipper	15	25	2	11	25	132	5·2	Smooth round. Medium cropper only
Early Baltimore ..	15	25	2	11	25	132	6·1	Smooth round, flat. Subject to "catface"
Scarlet Dawn ..	15	25	2	11	31 Feb.	138	7·0	Smooth round. Fair cropper. Best of the lot
Illinois Baltimore ..	15	25	2	11	2	140	6·5	Smooth round, flat. Medium cropper
Prairiana	15	25	2	11	5	143	5·2	Smooth round, flat. Shy cropper. Produced to suit the clay soils of the prairies
Norton's Wilt Resistant	15	25	2	11	5	143	5·2	Variable in habit. Subject to blossom end rot, "catface," &c. Shy cropper
Illinois Pride ..	15	25	2	11	5	143	5·2	Smooth round, slightly flat. Subject to "catface." Better as a late variety in clay soils
Pritchard	15	25	2	11	9	147	5·6	Smooth round, fair cropper. Inclined to run small unless on rich heavy soil. Fruit is not a good colour
Midseason Shipper ..	15	25	2	11	12	150	5·2	Smooth round, fair cropper as a late variety
Canner 114 ..	15	25	2	11	23	161	6·8	Flat crinkled, somewhat rough. Only a medium cropper, but flesh is of outstanding quality for canning purposes

* Although there was no appreciable difference in the period of germination, actually a very slight variation does occur; it varies according to the variety and the degree of case hardening of the seed. For practical purposes these slight variations are not recorded.

Wireless Talks for Farmers

WITH the co operation of the Australian Broadcasting Commission, the Victorian Department of Agriculture is conducting a series of wireless talks on subjects of particular interest to the man on the land. These talks are being broadcast from the regional stations, 2CO (Corowa), 3GI (Gippsland), and 3WV (Horsham) on Friday evenings, the 15-minute sessions commencing at 7.40 p.m.

The next talks will be on 9th June and 23rd June.

In order that these talks might be of maximum value to the farming community the Department is anxious to have the co-operation of listeners, who are invited to submit questions they would like answered over the air. If you have any particular problem connected with the management of your farm, your crops, or your live stock, or with the marketing of your produce, send a letter to Mr. J. Keane, B.Agr.Sc., Department of Agriculture, Melbourne. Your problem will then be submitted to expert officers of the Department, whose advice will be given. If you do not desire your name broadcast use initials or a nom-de-plume, but do not omit to mention your district.

Hydatid Disease of Animals and Man

Its Relation to Private Slaughter Houses and Farm Killing of Stock

By R. N. Wardle, B.V.Sc., Veterinary Officer.

SEVERAL classes of domestic animals are concerned with the parasitic infestation known as Hydatid disease. Before going fully into the life history of the parasite it should make things clear if the following brief statement is made.

Small tapeworms which inhabit the intestines of dogs have an intermediate cystic stage which develops from the eggs should they be eaten by sheep, cattle, pigs, or human beings; it should be realized that humans cannot become infested from the cysts found in these other animals. The cystic stage rarely inconveniences the domestic animals, but it causes serious illness in humans. The life cycle of the parasite is completed if dogs eat offal from affected animals when the tapeworms form from tiny heads present in the cysts.

The latest information shows that hydatid disease of man in Australia is still a serious one, there being relatively little decrease in the total number of cases of recent years. The risk run by inhabitants of those cities in which slaughtering is carried out at abattoirs is very slight. This is due to efficient meat inspection, whereby hydatid cyst infested livers and lungs are destroyed, and to health regulations in regard to control of dogs on or about the premises.

Sheep are more commonly affected than are cattle and pigs, hence dogs in sheep districts are more likely to be infested than are dogs in other areas. Following this reasoning it is found that the incidence in man varies with the sheep population of districts.

Life History.

The adult tapeworm (*Echinococcus granulosus*) inhabits the intestines of dogs; it is a very minute tapeworm less than a quarter of an inch in length. Eggs are laid and pass out with the faeces of the dog and may spread over pasture in dust blown by the wind. If these eggs be eaten by sheep, cattle, or pigs (for various reasons this is the order of importance of the intermediate host animal in Australia) they hatch out in the intestines and the embryos bore into the wall of this organ and enter the blood stream in which they are carried to the liver and lungs, where they develop very slowly as the larval or cystic stage. These cysts may continue growing for years when they may reach the size of a football or they may undergo degeneration and become calcified. Should infested livers or lungs be eaten by a dog, the numerous heads present in each cyst are liberated and develop into adult worms in the intestine and so the life cycle goes on.

In relation to this life cycle it should be noted that man occupies the same position in the life history of the parasite as do sheep, cattle, and pigs, all being infested only by swallowing the eggs which come from the adult worms in the dog. Once a man becomes affected the life cycle does not become completed, however. Man can never become infested from sheep, cattle, or pigs, but only from the dog, and the dog can never become infested without having first eaten fertile cysts in raw offal.

Infestation of Human Beings.

Infestation of man is now considered to be derived mainly from the handling of infested dogs whose coats and mouths may be contaminated with tapeworm eggs; such dogs are naturally those most likely to have access to uncooked offal. In a survey a few years ago some figures quoted by Ross and Gordon 1936, show the degree of infestation of different classes of dogs with the hydatid tapeworm.

Farm and station dogs—39 per cent. infested.
Slaughter yard dogs—30 per cent. infested.
Drovers' dogs—7 per cent. infested.

Farm and station dogs that are kept tied up contaminate the ground around their kennels with their faeces, thus liberating the minute eggs of the tapeworm which may survive in the dust for weeks or even months. It can readily be pictured how these dogs get their coats soiled with the dust containing the eggs. Handling, either in tying or untying or in fondling may transfer the tapeworm eggs to the person's hands and the careless handling of cigarettes, pipe or

handkerchief following the handling of the dogs forms a ready means for the transference of the eggs to the mouth.

Very small children who often play around in the ground in the vicinity of dog kennels, run greater risk than do adults, as they have no knowledge of hygiene, and apart from soiling their hands, they may even pick up and place in their mouths some object off the ground. Then of course, children also allow dogs to lick their hands and face, and dogs' mouths may be contaminated because of the habit they have of licking their coats and extremities.

Other methods of infestation of man are given briefly as follows :—

(*a*) From contamination of raw vegetables such as lettuce, radish, celery, &c., if dogs are allowed into vegetable gardens. This is not considered of such importance as formerly ; however, extra care should be taken in the washing of any vegetables that are eaten in the raw state.

(*b*) From drinking water. In these days this is hardly likely to take place.

(*c*) From food contaminated by flies. Flies are able to carry the egg of the tapeworm, hence this forms one of the reasons for the protection of food from flies.

(*d*) From the handling of sheep. This has nothing to do with sheep affected with the hydatid disease, but infestation of man may take place in handling live sheep whose wool may be soiled by dust containing tapeworm eggs. The wool would become contaminated when the sheep are in pens or yards the ground of which is often soiled by the sheep dogs.

Control Measures.

Briefly, control measures consist of :—

1. Preventing dogs from having access to raw offal, the important organs being lungs, liver, heart and spleen.

2. Freeing dogs from infestation with adult tapeworms.

3. Personal hygiene.

On farms and stations where sheep are slaughtered for home consumption it should be the practice for the liver, lungs, heart, and spleen to be lightly cooked before they are fed to dogs. A routine that might be observed is that the person doing the slaughtering should have a tin of boiling water ready into which the above mentioned organs are placed ; the tin is then placed on the fire and allowed to boil for ten minutes. Such procedure should be adopted even if the organs appear healthy, as many of the cysts may be small and buried in the tissue, in which case they can be found only by a careful examination by an expert.

In dealing with slaughter houses in the country great difficulty is likely to be experienced. It seems impossible to control all slaughtering by meat inspectors, but some means might be evolved whereby all organs, as before mentioned, are placed in a container and boiled for a short period immediately after a beast has been killed. Then very strict measures should be instituted to prevent dogs from frequenting these private slaughter yards and their environs.

A subject worthy of consideration is the establishment of group abattoirs for small towns in proximity to each other. Encouragement should be given to larger country municipalities for the establishment of abattoirs. Where such schemes for the grouping of municipalities for abattoir establishments were out of the question some years ago, the present age with fast motor traffic on good roads brings them within the realms of possibility.

In regard to the second item of control it can be stated with confidence that dogs can be treated efficiently for the eradication of tapeworms. This is a matter of educating the rural population.

Lastly, personal hygiene in connexion with the handling of farm and station dogs is again a matter of public education ; no better avenue for this can be found than through instruction in the schools both in ordinary classes and in those connected with Young Farmer's Clubs.

In concluding it might be well, in order to avoid misunderstanding, to point out that hydatid disease is in no way related to the presence of tapeworms in human beings. A tapeworm inhabiting the intestine of man has its cystic or intermediate stage in certain muscles of cattle only, and the life cycle is completed if humans eat beef containing cysts or measles and such beef must be raw or nearly so. The risk of infestation is very slight in a civilized community and the result of tapeworm infestation in man is not serious.

In hydatid disease, however, man can act as the host of the cystic stage of a dog tapeworm, and the result of this infestation is very serious and often has fatal results.

Reference.

Ross and Gordon—The Internal Parasites of Sheep, 1936

Fungicides Act 1935

Registrations for the Year 1939

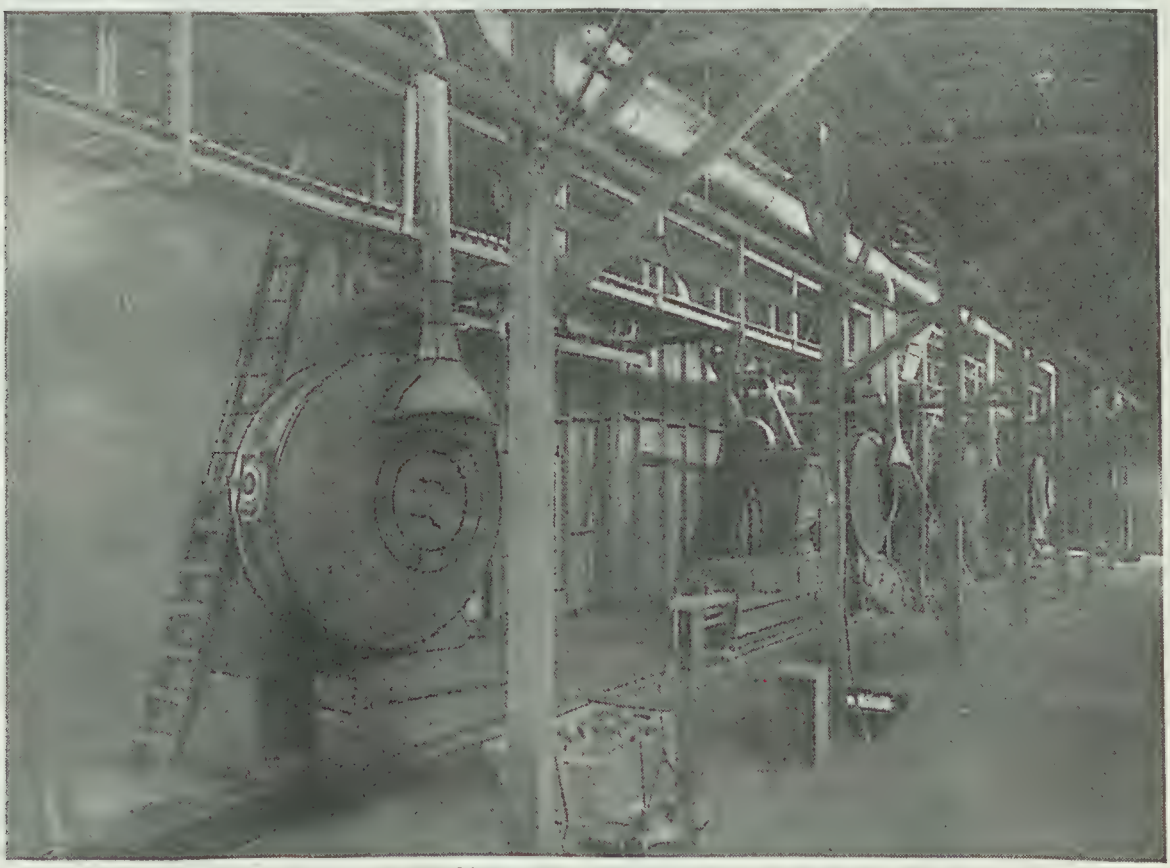
By W. C. Robertson, Chemist

MORE than 400 brands have been registered under the Fungicides Act for the current year. For the purposes of the Act the year commences on the first day of March and ends on the last day of February in the following year. Wholesale dealers, i.e., those primarily responsible for placing a pest destroyer on the market, are required to make application annually to the Director of Agriculture for registration of any Fungicide, Insecticide, Vermin or Weed Destroyer, which it is intended to sell or offer for sale during the year.

An application for registration must be on the prescribed form, and the fee for each registration is 10s. 6d., but no applicant will be called on to pay more than a total of £5 5s., irrespective of the number of destroyers he registers.

The Act also provides for the labelling of parcels containing any destroyer, whether it is fungicide, insecticide, vermin destroyer or weed destroyer, and the label must state the distinguishing brand name and guaranteed percentage of the active constituents.

The object of this provision is to enable the purchaser to ascertain readily the contents of any pest destroyer, and gives him further protection in compelling the seller to guarantee the quality of the fungicides, insecticides, &c.



A Sheep-dip-making plant.

The job of the Agricultural Chemist is to see that the quality guaranteed does not differ to any appreciable extent from the quality offered for sale.

Fortunately, although new pest destroyers of one class or another are continually being placed before the user, the old-time remedies still persist and the manufacturers of these have so standardized their works and methods that the quality of the common pest destroyers manufactured in Victoria shows little variation and compares more than favourably with those of other countries.

A general survey of the brands registered will show (*a*) nothing outstanding in the way of new remedies; (*b*) a vast amount of duplication; (*c*) an appreciable increase in the number of brands registered in the miscellaneous section; (*d*) the tendency to increase the use of rotenone and allied substances (oleo-resin) with arsenic and/or cresol in sheep dips; and (*e*) the increased popularity of blowfly preparations.

Blowfly Preparations.

It is interesting to note the variations in the composition of blowfly registrations, the registered brands for which disclose a guarantee for a single active ingredient through a range of substances up to six. These substances act in several ways thus:—Arsenic as a killer; tar oils a killer and an ovicide; eucalyptus oil an ovicide and repellent; mineral oil may act as an ovicide and "sticker"; phenol as a poison and antiseptic; boric acid as a healer.

Probably the perfect blowfly preparation is one which attracts to kill both as a poison and ovicide, and which has an antiseptic healing base.

One of the main problems, however, is to discover a "sticker" which will withstand the weather and retain the active constituents so that recurring "strikes" may be prevented or rendered harmless.

From this aspect neat oils may give better results than miscible or emulsified oils; though if an emulsified oil be used and the emulsification subsequently "breaks," then the "spread" of the oil, carrying the active ingredients over the whole of the sheep, should be helpful.

Sheep Dips.

A standard arsenical sheep dip, when diluted with water in accordance with the instructions on the label for the purpose of dipping sheep, must not contain less than 0·20 per cent. and not more than 0·25 per cent. of arsenic calculated as As_2O_3 and must not contain free caustic soda.

The minimum arsenic percentage may be regarded as the minimum amount required for killing efficiency and the maximum percentage as the danger limit. Some of the arsenical dual-purpose dips registered as miscellaneous dips contain arsenic (arsenious oxide) associated with derris extract and/or tar compounds.

There are six registrations of simple dips containing tar acids as the active ingredient, and a single instance of derris extract being used alone as a sheep dip.

As far as sheep dips are concerned, one may assume that the substance variously termed phenol, cresol, cresylic acid and tar acids is one and the same and is known in commerce as cresylic acid.

Crude derris extract contains the oleo-resin of cube or derris root with which rotenone is associated. "Tuba-toxins," which is one of the guaranteed active constituents in one brand of sheep dip, may be taken to mean derris root.

It should not be assumed that the percentage quoted greatly exceeds the percentages of rotenone and allied substances or oleo-resin which are correctly guaranteed in other brands.

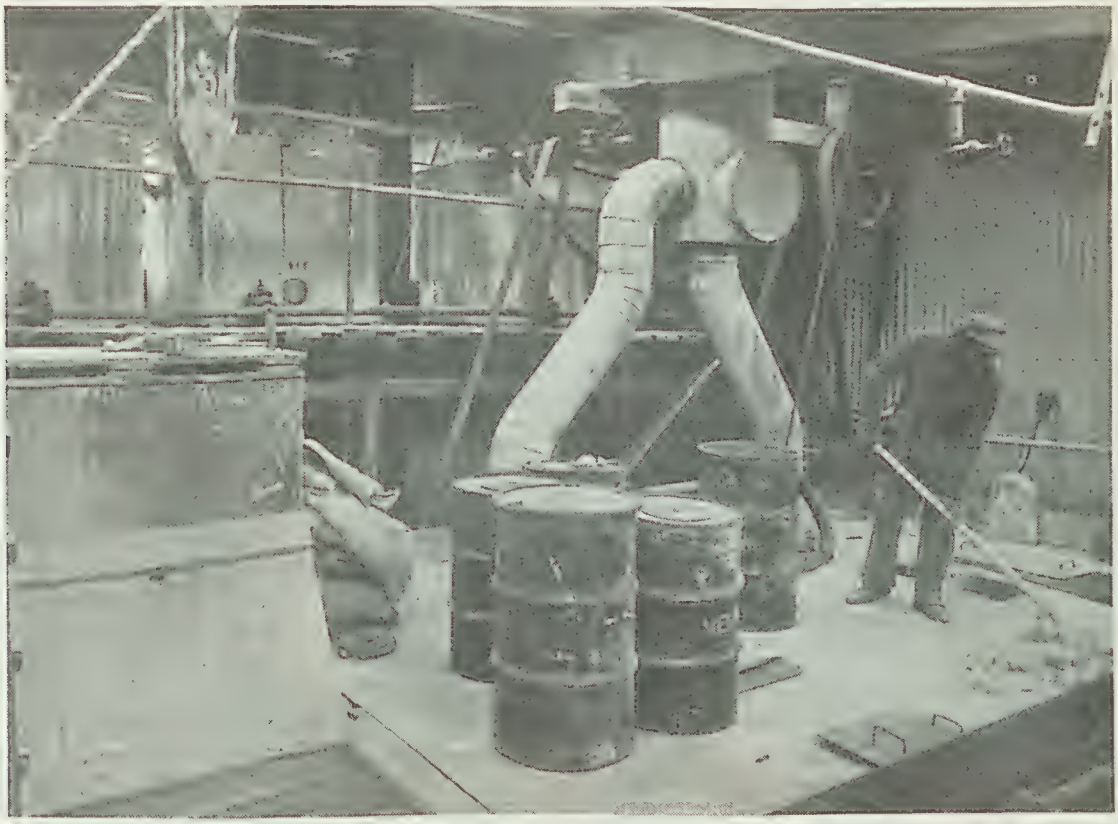
Commercial derris is marketed as the ground root—a light brown fibrous powder. Generally it is sold as a very fine powder containing a definite percentage of rotenone. However, owing to the difficulty in stabilizing the rotenone content, the tendency is to sell the ethereal extract or oleo-resin, which contains, in addition to rotenone, other highly toxic substances.

These preparations are much better and safer than the crude ground root itself. The derris or cube root, or the extract therefrom, resembles nicotine in being a natural insect poison. It is a contact insecticide, that is, unlike arsenic compounds, it is not essential that it should be eaten by the insect, but destroys by contact.

Dusts.

An interesting feature of the large number of dusting powders registered is that they are based on well-known simple insecticides and fungicides. The main insecticides used in their manufacture are lead arsenate and nicotine or nicotine sulphate, whilst the fungicides are either copper salts or sulphur with or without lime.

Most market gardeners who use dusts in preference to sprays prefer lead arsenate dusts as a killer in the early stages of growth and, should the pest survive, nicotine at a later stage when the crops approach maturity. The reason is



A lime sulphur plant showing portion of settling tanks and vents for taking off sulphur gases.

twofold. Firstly, the average consumer will not purchase vegetables showing pronounced dust deposit, and secondly the law prohibits the sale of vegetables heavily contaminated with lead and arsenic. The volatile nicotine insecticide presents no difficulty or danger in this respect because it is not retained on the crop for any length of time.

Most of the fungicides in commerce are characterized by a heavy metal or acid-forming group. It is noteworthy that sulphur decomposes into acid or acid-forming compounds when it oxidizes in air, and copper is one of the heavy metals which in the form of one or other of its compounds has long been used as a fungicide. These two types of chemicals are commonly assumed to owe their toxic action to their protein-precipitating power.

It is known that sulphur will oxidize to acid and therefore, as it owes its fungicidal action to its power as a protein-precipitant, one would assume that an acid atmosphere should be created for this type of fungicide to produce the best results. On the other hand, copper salts favour alkalinity and therefore their use is generally associated with caustic or slaked lime.

Whilst these facts are usually acknowledged in the "spray world," they are sometimes forgotten by the purveyor and user of dusts; so much so, that sulphur and a copper salt are often associated in a dust, and as sulphur will create acid conditions, the copper salt may not be able to act as an efficient fungicide. The remedy, of course, is to cover dust with lime, thereby making the alkaline conditions suitable for the copper fungicide. The object of the combined dust is to permit the sulphur to act first; if it is not the remedy for the fungus, then the material necessary for the second remedy—copper—is present.

The simple expedient of mixing two or more well-known insecticides or fungicides does not necessarily mean that one obtains something which is a certain remedy for all the pests that attack plants.

Sprays.

During last season many complaints were received of the burning or marking of fruit and

[*Continued on page* 301.

London Markets

Weekly Prices

The following information as to prices offering in London for the principal Victorian primary products has been taken from cablegrams received each week by the Department of Agriculture from the Victorian Agent-General in London.

Product.	Price for Week Ending—			
	5th May	12th May	19th May	26th May
	d.	*d.*	*d.*	*d.*
Lamb, 1st quality, Victorian .. .. 29–36 lb. ..	5⅞	5⅞	6	6⅛
Lamb, 1st quality, Victorian .. .. 37–42 lb. ..	5½	5½	5½	5⅝
Lamb, 1st quality, other States .. .. 29–36 lb. ..	6	6	6	6⅛
Lamb, 1st quality, other States .. .. 37–42 lb. ..	5⅝	5⅝	5⅝	5⅝
Lamb, 2nd quality, Victorian .. .. 28 lb. and under	6½	6½	6½	6⅝
Lamb, 2nd quality, Victorian .. .. 29–36 lb. ..	5⅞	5⅞	5⅞	5⅞
Lamb, 2nd quality, other States .. .. 28 lb. and under	6½	6½	6½	6½
Lamb, 2nd quality, other States .. .. 29–36 lb. ..	5⅝	5½	5½	5⅝
Lamb, 3rd quality, all States .. .. 28 lb. and under	6	6	6⅛	6¼
Lamb, 3rd quality, all States .. .. 29 lb. and over	4⅞	5	5	5⅛
Mutton wethers and/or maiden ewes .. Under 40 lb. ..	3⅜	3⅜	3⅜	3⅜
Mutton wethers and/or maiden ewes .. 41–48 lb. ..	3⅛	3⅛	3⅛	3⅛
Mutton wethers and/or maiden ewes .. 49–56 lb. ..	3	3	3	3
Mutton ewes .. .. Under 40 lb. ..	3¼	3¼	3¼	3¼
Mutton ewes .. .. 41–48 lb. ..	3	3	3	3
Beef, frozen ox hinds .. .. .. 145–210 lb. ..	3⅞	3⅞	3⅞	3⅞
Beef, frozen ox crops, weights corresponding	3	3	3	3⅛
Beef, chilled ox hinds .. .. .. 145–210 lb. ..	4¼	5	4⅝	4⅝
Beef, chilled ox crops, weights corresponding	3	3⅛	3¼	3⅛
Pork, Australian 1st quality .. .. 60–80 lb. ..	6½	6½	6½	6⅝
Pork, Australian 1st quality .. .. 81–100 lb. ..	6½	6½	6½	6⅝
Pork, New Zealand, 1st quality .. .. 60–80 lb. ..	6½	6½	6½	6⅝
Pork, New Zealand, 1st quality .. .. 81–100 lb. ..	6½	6½	6½	6⅝
	s.	*s.*	*s.*	*s.*
Bacon, Canadian .. .. .. per cwt. ..	80	80	80	80
Bacon, Empire (cured in England) .. .. per cwt. ..	79	79	79	79
Bacon, Danish .. .. per cwt. ..	90	90	90	90
Butter, unsalted, choicest grade .. .. per cwt. ..	113–114	109–110	106–107	108–110
Butter, unsalted, 1st grade .. .. per cwt. ..	110–112	107–108	104–105	106–107
Butter, unsalted, 2nd grade .. .. per cwt. ..	..	..	..	..
Butter, unsalted, pastry grade .. .. per cwt. ..	..	..	..	..
Butter, salted, choicest grade .. .. per cwt. ..	110–111	106–107	103–104	107–108
Butter, salted, 1st grade .. .. .. per cwt. ..	109–110	105–106	102–103	106–107
Butter, salted, 2nd grade .. .. .. per cwt. ..	106–107	102–103	98–100	102–104
Butter, salted, pastry grade .. .. per cwt. ..	102	98	95	98
Butter, Danish .. .. per cwt. ..	124	124	121	117
Market (butter)	Slow.	Market declined throughout the week.	An improved demand at the lower prices.	Good demand at improving prices.

Pasture Investigations

(continued from page 266)

Little or no growth was made during the winter, and though normal rains which fell in August promoted some early spring feed, it was only in the North-east and the southern area of the Western District that this growth was assisted by following rains. Over the whole State very dry weather was experienced in mid and late spring, and by January, the paddocks were bare and there were few reserves of grass hay available for future feeding.

Fattening cattle in the Mansfield district.

Fortunately stock held their condition well on the short top-dressed pastures and assisted by the low price of feed wheat, and large hay supplies brought in from the eastern Riverina, the State has emerged from this record dry period in far better condition than from previous droughts.

The ability of superphosphate to develop pastures capable of making appreciable growth during the winter period, the superior quality of the feed on these top-dressed pastures, and the rapid recovery of the improved pastures once the rains occurred, have been the outstanding lessons of this period.

Results of Major Plots

GIPPSLAND AND WESTERN DISTRICT

Details of the yields obtained in the earlier years are to be found in the previous annual reports. This report is confined mainly to the 1938 results but tables showing the total annual yields of produce from the manurial trials are also included. Owing to the very unfavorable season few mowings were necessary last year, and the total yields were exceptionally light.

(Caldermeade J. Davies).

Mean Rainfall 30.5 *inches.*

The Caldermeade plot is situated on a deep fertile clay loam, the pasture consisting of perennial rye, subterranean and white clover with Kentucky blue and some flat weed (*Hypochoeris*).

This plot has always given a marked response to superphosphate and despite the repeated cutting and removal of produce has maintained its yields well. As might be expected under these circumstances potash treated plots have not shown any material increase in growth.

The results obtained from the mowing manurial trial are shown in Table I.

Korumburra (F. E. Kurrle).

Mean Rainfall 46.1 *inches.*

The Korumburra plot is situated on the fertile grey hill soil typical of the district. Favoured by a liberal rainfall the soil supports a good pasture of Yorkshire fog, cocksfoot, perennial rye, subterranean and white clovers.

The plot has shown a sustained good response to superphosphate, but although lime gave a fair response in the early years, the effect of the 1 ton dressing given in 1932 has more recently declined. The response to potash on this trial has been small only.

The results obtained are set out in Table I.

TABLE I.—RELATIVE YEARLY PRODUCTION FROM VARIOUSLY MANURED PLOTS (MOWING TRIALS) GIPPSLAND, 1932-38.

The production of the unmanured plots is expressed as 100. The "year" extends from 1st March to 28th February, except for the year 1932, when the mowing did not commence until July.

Year.	No Manure.	Super. 2 cwt.	Super. 2 cwt., S. of A. 1 cwt.	Super. 2 cwt., S. of A. 1 cwt. Lime 1 ton.	Super. 2 cwt., S. of A. 1 cwt., Potash 1 cwt.	Super. 3 cwt.
Caldermeade.						
1932	100	151	148	147	147	156
1933	100	183	181	199	194	202
1934	100	182	165	178	179	202
1935	100	168	161	162	177	168
1936	100	203	189	194	206	207
1937	100	148	149	153	161	158
1938	100	287	308	345	342	305
Korumburra.						
1932	100	118	125	143	131	132
1933	100	184	178	228	199	210
1934	100	163	134	165	153	171
1935	100	170	148	177	172	179
1936	100	173	160	178	177	187
1937	100	196	183	198	217	216
1938	100	265	245	276	300	297
Warragul.						
1932	100	111	122	156	128	119
1933	100	112	162	194	183	118
1934	100	123	122	145	131	137
1935	100	153	120	186	144	163
1936	100	179	136	157	189	188
1937	100	124	114	143	158	162
1938	100	172	237	379	351	242

Warragul (C. Tyssen).

Mean Rainfall 40.5 *inches.*

The soil at Warragul—a deep crumbly red clay, derived from older basalt—is typical of the Gippsland red hill country.

When first established this plot had a pasture of cocksfoot and red clover, but the latter has now been largely replaced by subterranean clover. An attack by underground grass grubs thinned out the cocksfoot in 1937 and this, coupled with the bad season of 1938, resulted in very poor yields being obtained.

In the first years the response to superphosphate was small, while the lime and sulphate of ammonia responses were marked. More recently the lime and sulphate of ammonia responses have declined, while the responses to superphosphate and to superphosphate and potash have tended to increase.

The results obtained from this section are set out in Table 1.

NEW SERIES—GIPPSLAND.

In 1935 a number of new mowing trials was established to ascertain to what extent the results then being obtained on the major plots at Warragul and Mirboo North would be applicable to the surrounding districts. At both these centres good results had been obtained with lime used in conjunction with superphosphate, and these new trials were designed mainly with the object of ascertaining the response to lime when used alone, and in conjunction with phosphates and nitrogen. Up till the time that these plots were commenced no material response to potash had been recorded in these districts, and no provision was made for including potash in those trials.

The areas selected for the new plots were required to possess a fairly level ground surface, and to consist of uniform and reasonably dense pasture swards, typical of the districts. At Mirboo North lime responses similar to those recorded on the original major plot have been obtained, but at Warragul the response to lime has been small, and it now appears that the best results are to be obtained from superphosphate plus potash. During the past year, yields were exceedingly low, only about one-quarter of the normal growth being produced.

Warragul (T. Boardman).

The pasture on Mr. Boardman's property consisted mainly of cocksfoot with some red, white, and subterranean clovers. It has usually shown good growth in the late spring, but appeared to be lacking in vigour during the winter. Neither lime, superphosphate, nor sulphate of ammonia has shown satisfactory results on this plot, but recent exploratory dressings of potash have given very substantial increases.

Table II. shows the extent of the increases obtained during the past spring from plots receiving an additional dressing of 1 cwt.

muriate of potash per acre per annum as compared with those receiving the normal manuring.

TABLE II.—RESPONSE TO POTASH (SPRING, 1938)—(T. BOARDMAN).

Yield due to—	Yields in cwt. of Greenstuff per Acre.				
	No Manure.	Super. 2 cwt.	Super. 2 cwt., S. of A. 1 cwt.	Super. 2 cwt., S. of A. 1 cwt., Lime 1 ton.	Super. 2 cwt., Lime 1 ton.
Normal manuring	16	39	46½	42½	33½
Normal manuring + potash ..	..	73½	66	81	96

Lardner (R. S. Teese).

Mr. R. S. Teese's pasture consists of a dense cocksfoot, Yorkshire fog, subterranean clover sward which previously had been regularly top-dressed for many years.

The "no-manure" plots have continued to yield as well as those receiving superphosphate 2 cwt., and the lime and nitrogen treatments have not overcome this unusual condition. Trial dressings of potash applied to a section of this plot in 1936, 7 and 8 have shown very marked increases in the spring, and afford an explanation of the lack of response of this pasture to superphosphate, lime, and nitrogen.

The general results from this trial are set out in Table VI., while the spring increase due to potash is shown in Table III.

TABLE III.—SPRING (1938) RESPONSE TO POTASH (LARDNER).

Yield due to—	Yields in cwt. of Greenstuff per Acre.				
	No Manure.	Super. 2 cwt.	Super. 2 cwt., S. of A. 1 cwt.	Super. 2 cwt., S. of A. 1 cwt., Lime 1 ton.	Super. 2 cwt., Lime 1 ton.
Normal manuring	19	17	28½	33	24½
Normal manuring + potash ..	..	74	72½	88	87

Warragul (C. Tyssen).

The plot on Mr. Tyssen's property is situated near the old major plot mowing area, and while the soil is of similar origin and structure to that of the old plot, the pasture is of a very different composition, consisting mainly of Yorkshire fog and danthonia with subterranean white and suckling clovers and a good deal of plantain and flat weed.

Unlike the major mowing trial area this plot has shown a good increase to superphosphate while the response to lime and sulphate of ammonia has been small only. The results obtained from this trial are shown in Table VI.

The results from exploratory dressings of muriate of potash 1 cwt. per acre applied to portion of the plot show considerable increases from the use of this fertilizer (see Table IV.).

TABLE IV.—SPRING (1938) RESPONSE TO POTASH (C. TYSSEN).

Yield due to—	Yields in cwt. of Greenstuff per Acre.				
	No Manure.	Super. 2 cwt.	Super. 2 cwt., S. of A. 1 cwt.	Super. 2 cwt., S. of A. 1 cwt., Lime 1 ton.	Super. 2 cwt., Lime 1 ton.
Normal manuring	21½	80½	79	85½	85½
Normal manuring + potash ..	..	129½	91½	128	134½

GRAZING TRIAL—ELLINBANK.

At the time that the new series mowing trials were commenced in the Warragul district a small grazing trial was established at Ellinbank on an impoverished pasture consisting mainly of Yorkshire fog, flat weed, and rib grass with a little weak perennial rye, cocksfoot, and subterranean clover. It was considered that this pasture was too poor to justify the use of a mowing trial to determine

TABLE V.—WEIGHTS OF GREENSTUFF OBTAINED FROM MOWN STRIPS ON GRAZING AREAS, ELLINBANK—EACH THREE STRIPS 44 FEET X 20 INCHES.

Treatment.	Greenstuff. lb.
No manure	2·0
Super. 1 cwt.	3·2
Super. 2 cwt.	6·2
Super 2 + Lime 1 ton	8·7
Super. 2 + Sulph. of Amm. 1 cwt. ..	9·7
Super. 2 + Nitro chalk 1·3 cwt. ..	13·2
Super. 2 + lime 1 ton + S. of A. 1 cwt...	23·7

the soil deficiency, and a number of small grazing plots each $\frac{1}{6}$ acre in extent were individually fenced and manured. These plots have been grazed off at intervals and should in consequence have received a return of dung and urine proportional to the amount of grazing derived from them.

On this trial good results have been obtained only when superphosphate, lime, and sulphate of ammonia have all been applied and though a cross strip of potash has sometimes shown good increases this fertilizer has not given as marked results as have been recorded in other parts of the Warragul district. Very marked manurial responses have been recorded each spring, and during the past spring an effort was made to measure this increased growth, small areas from each plot being mown and weighed. Table V. shows the weight of produce obtained from each area.

Similar results have been obtained each spring, and though they confirm the early results obtained on the Warragul major plot, they are very different from the results now being obtained on the other mowing plots in the Warragul district.

The results of the numerous trials conducted in the Warragul district indicate that the likelihood of the response to fertilizer is determined more by the previous history of the paddock and the present composition of the sward, rather than by the soil type. This appears to be the explanation of the conflicting opinions of local farmers as to the most effective manures required in the district.

MIRBOO NORTH—NEW SERIES TRIALS.

Good responses to lime, when used in conjunction with superphosphate, were recorded on the original major plot established at Mirboo North. In 1935, new mowing plots were laid down to determine if lime would be of benefit in other parts of the district. The results since obtained have confirmed the findings of the old major plot and it has been found that lime in addition to superphosphate has shown a good response on these new series trials. Exploratory trials with potash in this district have not shown any material response.

Mirboo North (Edney Bros).

Messrs. Edney Bros.' plot is situated on a pasture consisting of Yorkshire fog, cocksfoot, and danthonia with some subterranean and white clovers. The results show a good response to superphosphate, and a further considerable response to lime in addition. Lime, either alone or with sulphate of ammonia, has not increased growth over the unmanured plots. The yields during the past season have been exceptionally low owing to the dry weather.

The relative yields obtained from this plot are shown in Table VI.

Mirboo North (L. J. Austin).

The pasture on the plot situated on Mr. L. J. Austin's property is lacking in vigour. It consists of cocksfoot, Yorkshire fog, flat weed, and plantain with a little red and suckling clovers.

TABLE VI.—RELATIVE YEARLY PRODUCTION FROM VARIOUSLY MANURED PLOTS (NEW MOWING TRIALS)—GIPPSLAND, 1936, 1937, AND 1938.

Year.	No Manure.	Super. 2 cwt.	Super. 2 cwt., S. of A. 1 cwt.	Super. 2 cwt., Lime 1 ton.	S. of A. 1 cwt., Lime 1 ton.	Super. 2 cwt., S. of A. 1 cwt., Lime 1 ton.	Lime 1 ton.
Limonite (G. W. Bickerton).							
1936 ..	100	121	125	186	117	174	116
1937 ..	100	120	114	167	105	157	98
1938 ..	100	148	151	231	111	226	118
Mirboo North (Edney Bros.).							
1936 ..	100	168	155	181	112	174	115
1937 ..	100	165	162	216	111	204	93
1938 ..	100	315	333	464	131	463	98
Mirboo North (L. J. Austin).							
1936 ..	100	146	138	185	130	192	146
1937 ..	100	153	146	202	139	212	141
1938 ..	100	221	221	280	160	325	161
Warragul (C. J. Snipe, now T. Boardman).							
1936 ..	100	116	106	120	98	119	88
1937 ..	100	129	128	131	98	131	80
1938 ..	100	223	256	203	116	243	93
Lardner (R. S. Teese).							
1936 ..	100	101	100	98	93	96	92
1937 ..	100	86	99	95	95	101	87
1938 ..	100	89	138	128	145	160	104
Warragul (C. Tyssen, No. 2).							
1936 ..	100	151	156	168	103	177	101
1937 ..	100	190	174	208	95	193	99
1938 ..	100	354	348	379	107	379	72

The plots treated with superphosphate have shown better growth than the unmanured ones, while those receiving lime in addition have been still further improved. On this area both

lime alone, and lime and sulphate of ammonia have effected an appreciable improvement. The relative yields obtained are shown in Table VI.

Limonite (G. W. Bickerton).

The plot at Limonite has usually made stronger growth than the other plots in the Mirboo North district and again during the past year it made a better showing under the adverse conditions. The pasture consists of vigorous cocksfoot, Yorkshire fog, and subterranean clover with some red and white clover, and the usual rosette weeds. Superphosphate has shown a small increase only in bulk of produce, but the additional dressing of lime has given a good response.

The relative weights of produce obtained are shown in Table VI.

WESTERN DISTRICT.

As a result of the very unfavorable weather experienced during the year, the total yields on the Western District plots have been very low. Very dry conditions were experienced in the autumn and winter, and an exceptionally poor spring followed. Growth therefore was much lighter than usual. The relative increases effected by the manurial treatments, although more marked than usual, have been similar to those of the previous years. The response to superphosphate alone has again, in many instances, been poor, while superphosphate and potash has given a very good response. Sulphate of ammonia and lime generally did not show any appreciable increase.

At both Cobrico and Larpent the policy of giving a basal dressing of 1 cwt. muriate of potash to the centre bay of the mowing plots has been continued, and these treated bays have again shown a very marked superiority of growth as compared with the untreated sections.

Plots which early in their history showed signs of response to potash, have been the first to show signs of weakening under the continued mowing. Such swards may be restored rapidly to vigour by the application of mixed phosphate-potash fertilizer, providing the clovers have not been completely eliminated.

The swards on the depleted plots on the drier soils tend to develop an excess of sorrel, Yorkshire fog, and flat weed (*Hypochoeris*), while the perennial rye-grass develops an apparent sensitivity to the mowing and readily dies out. Several of small observational potash plots located on grazing areas through the Colac and Cobden districts have shown good responses to potash, and indicate that eventually the highly improved pastures on the lighter soils of the southern Western District will be maintained only by the use of mixed fertilizers.

Larpent (J. J. Rogers).

Mean Rainfall 27.4 inches.

The Larpent plot is situated on a deep, good sandy loam which carried a good sward of perennial rye-grass and subterranean clover when the tests were commenced. This plot showed signs of a marked potash deficiency from the outset and the sward declined rapidly under the repeated mowing. The plot strips receiving superphosphate only, or superphosphate and ammonia deteriorated very rapidly, but on both the "no manure" and the superphosphate and potash plots the swards have continued to be of satisfactory composition.

TABLE VII.—RELATIVE YEARLY PRODUCTION FROM VARIOUSLY MANURED PLOTS (MOWING TRIALS)—WESTERN DISTRICT, 1932-38.

The production of the unmanured plots is expressed as 100. The "year" extends from 1st March to 28th February, except for the year 1932, when the mowing did not commence until July.

Year.	No Manure.	Super. 2 cwt.	Super. 2 cwt., S. of A. 1 cwt.	Super. 2 cwt., S. of A. 1 cwt., Lime 1 ton.	Super. 2 cwt., S. of A. 1 cwt., Potash 1 cwt.	Super. 3 cwt.
			Larpent.			
1932 ..	100	162	170	178	195	176
1933 ..	100	137	142	144	150	140
1934 ..	100	151	139	139	180	133
1935 ..	100	98	113	128	215	110
1936 ..	100	120	122	129	226	123
1937 ..	100	97	119	119	173	94
1938 ..	100	111	139	144	201	101
			Coragulac.			
1932 ..	100	114	120	126	129	121
1933 ..	100	119	125	123	124	127
1934 ..	100	117	109	105	99	114
1935 ..	100	128	133	125	127	124

TABLE VII.—*continued.*

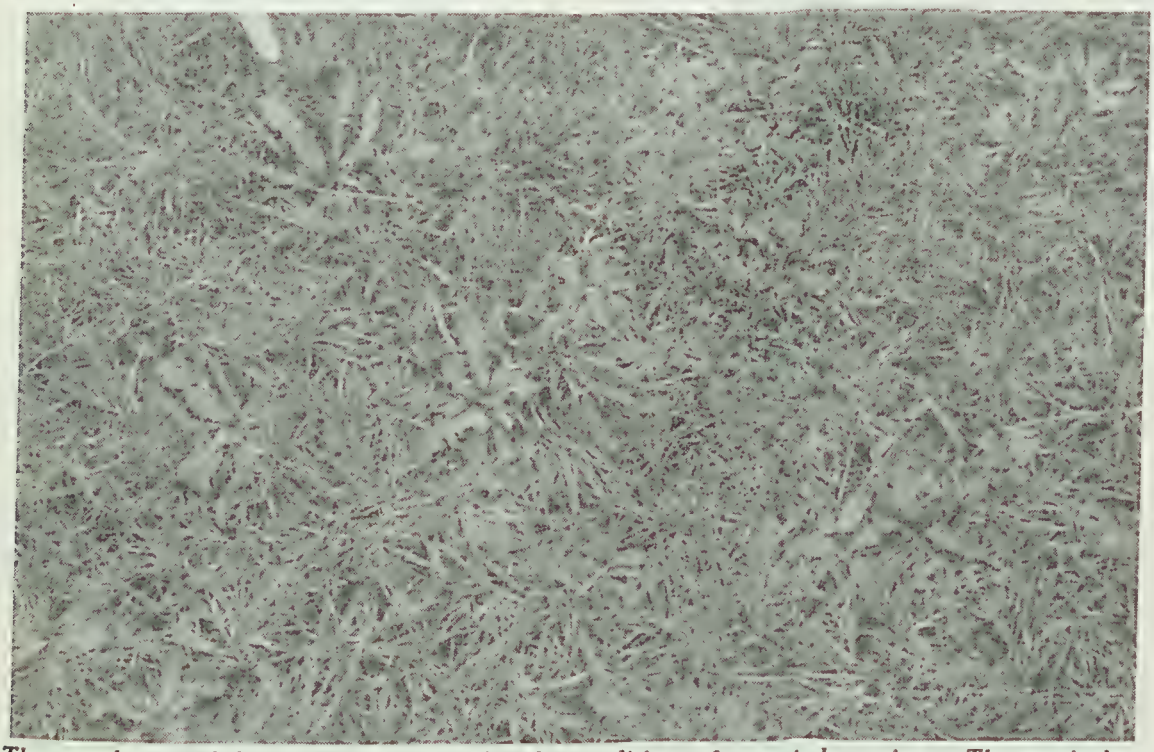
Year.	No Manure.	Super. 2 cwt.	Super. 2 cwt., S. of A. 1 cwt.	Super. 2 cwt., S. of A. 1 cwt., Lime 1 ton.	Super. 2 cwt., S. of A. 1 cwt., Potash 1 cwt.	Super. 3 cwt.
Glenormiston North.						
1932 ..	100	114	116	121	115	113
1933 ..	100	109	107	112	117	110
1934 ..	100	132	106	110	109	132
1935 ..	100	118	103	106	126	118
1936 ..	100	133	131	129	165	135
1937 ..	100	126	123	126	154	132
1938 ..	100	143	158	174	209	151
Cudgee.						
1932 ..	100	163	170	147	164	168
1933 ..	100	153	164	164	187	159
1934 ..	100	178	135	132	150	176
1935 ..	100	116	114	117	176	125
1936 ..	100	131	142	147	239	136
1937 ..	100	114	130	134	204	112
1938 ..	100	132	159	160	235	123
Cobrico.						
1932 ..	100	122	115	119	144	118
1933 ..	100	129	160	162	202	135
1934 ..	100	132	121	128	166	138
1935 ..	100	126	124	137	253	128
1936 ..	100	118	122	129	264	121
1937 ..	100	124	125	138	194	134
1938 ..	100	150	175	193	259	168

In the former case the rate of depletion of soil potash has apparently not been sufficiently rapid to bring about a potash deficiency, while, in the latter, the added potash has been sufficient to compensate for the amount removed in the greenstuff. The case for superphosphate and potash on this pasture has been fully proved, but the plot is being continued to determine the possibility of any other minerals becoming growth-limiting factors on the area.

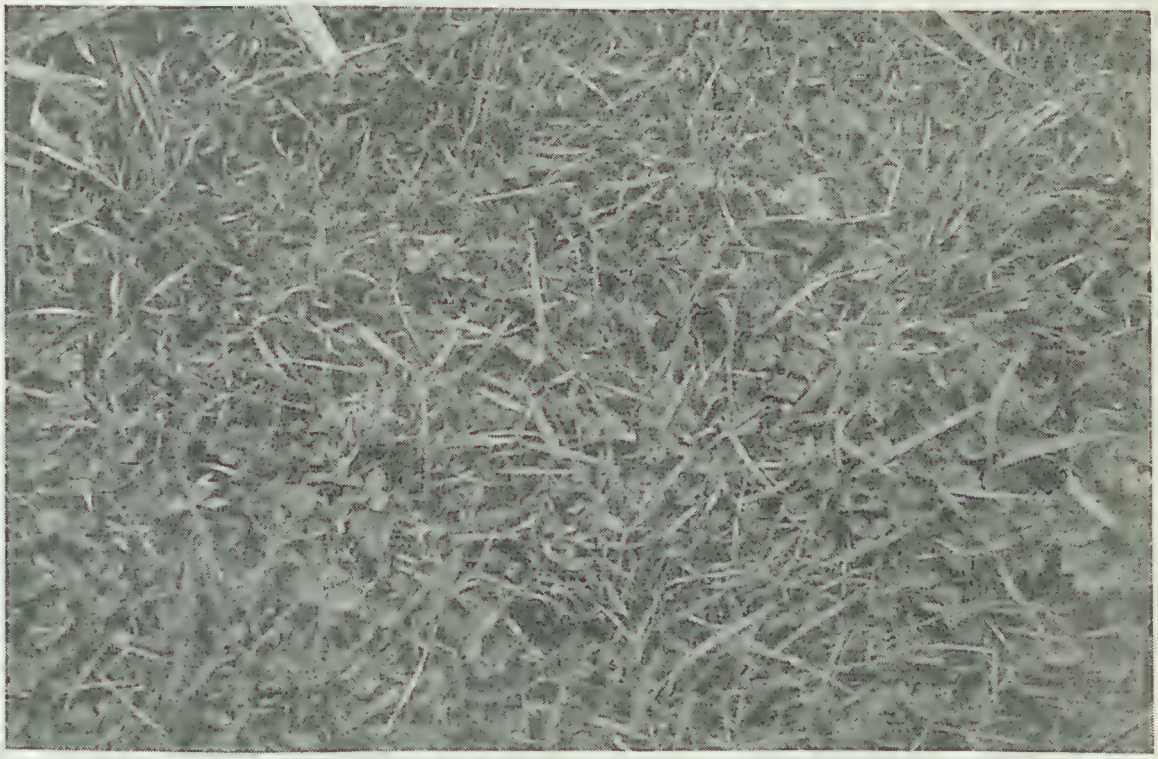
The relative yields obtained from this plot are shown in Table VII.

TABLE VIII.—SPRING RESPONSE TO POTASH—LARPENT.

	Yields in cwt. of Greenstuff per Acre.					
	No Manure.	Super. 2 cwt.	Super. 2 cwt., S. of A. 1 cwt.	Super. 2 cwt., S. of A. 1 cwt., Lime 1 ton.	Super. 2 cwt., S. of A. 1 cwt., Potash 1 cwt.	Super. 3 cwt.
Yield due to—						
Normal Manuring	17½	19½	29	30	45½	16½
Normal Manuring + Potash	15	37½	39	47½	46½	30½



The sward on the Cobrico plot deteriorated under conditions of repeated mowing. The particular area shown obove had received superphosphate only. (3 cwt. per acre).



Showing the marked improvement in the sward illustrated on the previous page, after potash had been applied.

Comparative yields obtained from plots receiving the normal manuring and those recieving a basal dressing of 1 cwt. per acre muriate of potash in addition, during spring 1938, are set out in Table VIII.

Cobrico (N. Maskell).

Mean Rainfall 27.5 inches.

The Cobrico plot is situated on a soil which, though naturally of light carrying capacity, had been greatly improved by regular top-dressing previous to the establishment of the trial. The pasture, which consists of perennial rye, sweet vernal, subterranean and white clovers with Yorkshire fog and flat weed, had in its early history responded well to top-dressing with superphosphate, but at the time that the experiment was commenced it was considered by the owner that the response was not as good as it had been in the earlier years.

From the commencement of the test this pasture gave a good response to potash, while the response to superphosphate alone has never been more than small. Though sulphate of ammonia has frequently shown an increased growth in the early spring, its effect over the year has not been beneficial. Lime has sometimes shown a small beneficial effect on the mowing plots, and it appears to have resulted in an improved growth on the grazing areas.

TABLE IX.—SPRING RESPONSE TO POTASH—COBRICO.

	Yields in cwt. of Greenstuff per Acre.					
	No Manure.	Super. 2 cwt.	Super. 2 cwt., S. of A. 1 cwt.	Super. 2 cwt., S. of A. 1 cwt., Lime 1 ton.	Super. 2 cwt., S. of A. 1 cwt., Potash 1 cwt.	Super. 3 cwt.
Yield due to—						
Normal Manuring	15	27	37	40½	66	31
Normal Manuring + 1 cwt. Potash	22½	77½	76	79	85	71½

The relative yields obtained are shown in Table VII.

Under the conditions of repeated mowing the sward on the plot at Cobrico deteriorated, and it was decided to give a basal dressing of potash to the centre section of the mowing plot area. This resulted in a marked improvement in the sward, and a large increase in

growth on those strips which received superphosphate as their normal dressing.

Table IX. shows the extent of the increased growth obtained last spring.

Glenormiston North (K. Atkins).

Mean Rainfall 28.9 *inches.*

The plot at Glenormiston North is situated on a fertile deep clay loam having a pasture of perennial rye and subterranean clover with some Yorkshire fog. This pasture had been frequently top-dressed before the experimental plot was established, and probably as a consequence of this treatment its response to superphosphate has been small only. More recently there has been a fair response to potash, but it would appear that the soil is sufficiently rich to withstand repeated mowing for some years without showing obvious signs of exhaustion. Neither lime nor sulphate of ammonia has effected any improvement in this trial.

The relative yields are set out in Table VII.

Cudgee (E. R. Murfitt).

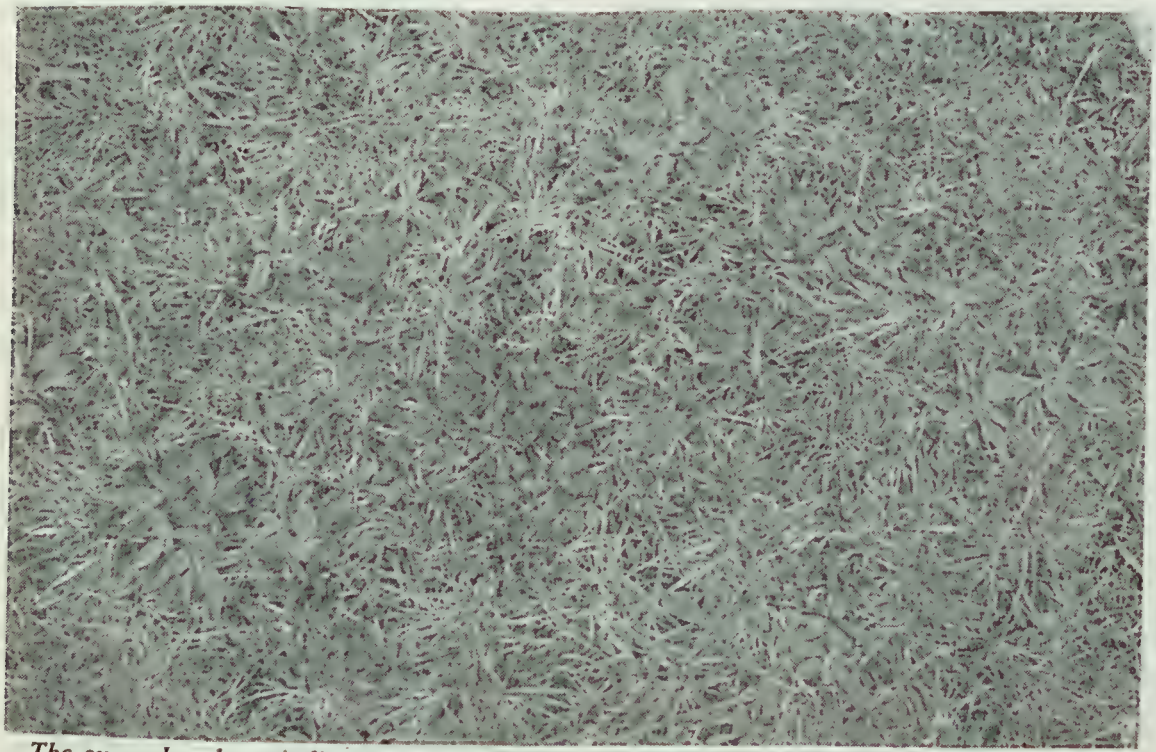
Mean Rainfall 27.5 *inches.*

The pasture on Mr. E. R. Murfitt's property is typical of the well improved pasture on light land in the Cudgee district. The soil is a fine sandy loam carrying a pasture of perennial rye, cocksfoot, and subterranean clover. An excellent response to superphosphate was obtained in the early years, during which time the addition of potash did not effect any further improvement. Since then, however, the response to superphosphate has declined, while the response to superphosphate and potash has become very marked. Both lime and sulphate of ammonia have been ineffective in increasing the annual yields.

The relative yields from the Cudgee trial are shown in Table VII.

NEW SERIES MOWING TRIALS.—WESTERN DISTRICT.

New mowing trials were commenced in the Colac and Cobden districts in 1935, to determine the extent of the potash deficiency which had been demonstrated in the major plots located in those districts. These new plots were located on the lighter pasture areas, generally on soils which had been regarded as being very responsive to superphosphate, but on which the pastures did not appear to be making very satisfactory winter growth.



The superphosphate + lime plot on Mr. J. Errey's property. Note the poor type of sward.

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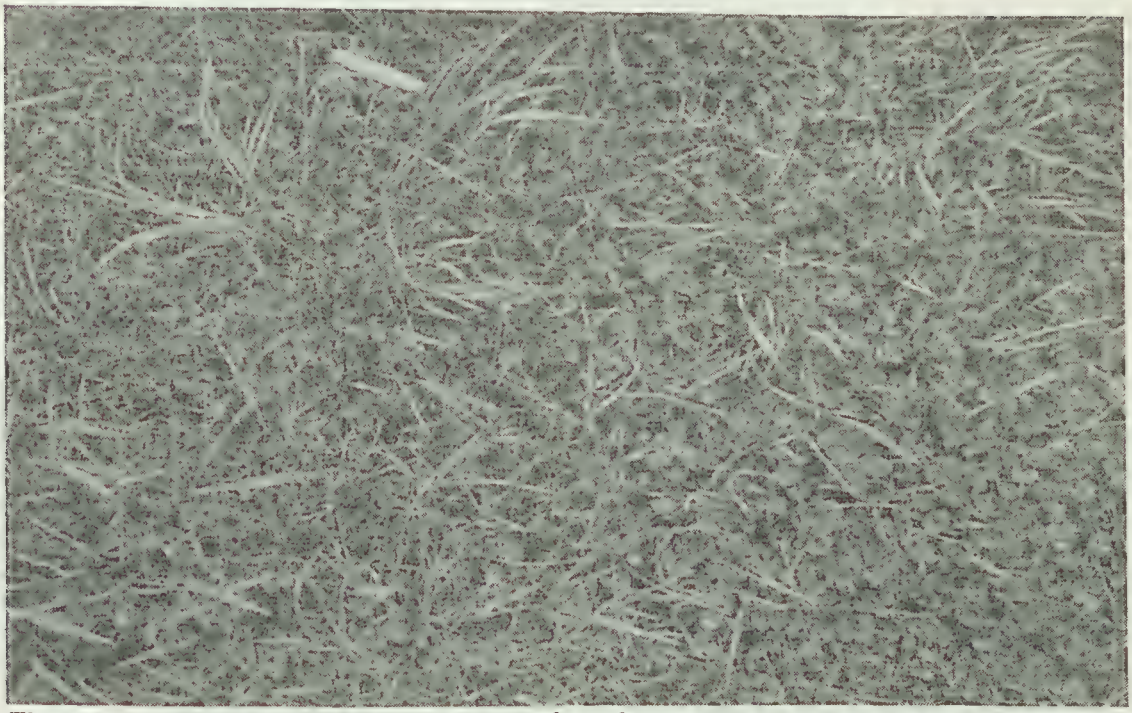

The addition of potash to the sward illustrated on the previous page effected a considerable improvement in its composition. Note the strong clover growth.

Most of these plots have shown, from the beginning, an increase due to potash. Where a good response to superphosphate was obtained, the response to potash has usually been small, but where or when the response to superphosphate was small, the response to potash became very much more marked.

Cobden District (J. Roberts).

The plot on Mr. J. Robert's property was situated on a perennial rye, sub-clover, Yorkshire fog, sweet vernal, bent grass pasture with some flat weed and white clover. This pasture had previously received little or no top-dressing with superphosphate, but considerable quantities of stable manure had been applied to the area.

In the first years, there was a good response to superphosphate, and a further response to potash in addition. More recently the superphosphate response had declined, and the potash response has increased. Sulphate of ammonia has not given increased yields, but lime applied to plots receiving superphosphate and potash has brought about some increase in growth.

The relative yields obtained from this plot are shown in Table X.

Cobden (L. Vagg).

Mr. L. Vagg's pasture, consisting mainly of perennial rye with sub and white clovers, has usually made good growth and did not appear to be suffering from any unusual manurial deficiency. It has given a very good response to superphosphate, which has been well sustained. A response to potash has been recorded on this plot, but it is, as yet, not so marked as the responses recorded on other plots in the district.

Neither lime nor sulphate of ammonia has shown any beneficial effect on this plot.

The relative amounts of produce obtained are set out in Table X.

Cobden (R. T. Stone).

The pasture on Mr. R. T. Stone's plot consists of perennial rye, subterranean and white clovers, with Yorkshire fog, sweet vernal, and flat weed. The plot is situated on portion of the weaker pasture of the farm, which is typical of much of the shallow basalt soils found in the Cobden district.

This pasture had been developed by repeated annual dressings of superphosphate, and had reached a stage when the response to superphosphate had declined. The experimental

plot has confirmed this lack of response to superphosphate, and it has been found that, unless potash is applied in addition, superphosphate alone is comparatively ineffective.

Very marked responses to the potash treatment have been obtained, but neither lime nor sulphate of ammonia has been of any benefit.

Table X. shows the relative yields obtained from this plot.

Cobden (J. Errey).

The pasture at Mr. J. Errey's is situated on a grey basalt soil of normal depth, carrying a pasture of sweet vernal, perennial rye, Kentucky blue, with white, subterranean, and suckling clovers, and a good deal of flat weed. This pasture had been developed by frequent dressings of superphosphate, but as a result of recent grass-hay cutting the productivity had declined.

Superphosphate has effected little improvement compared with the unmanured plots and the addition of lime did not alter the situation. Superphosphate and potash, however, have effected a big improvement in the pasture, and the addition of lime to this combination has increased the productivity still further. It is apparent that the use of superphosphate only on soils which have reached this stage of depletion can only give indifferent results, and that a combined superphosphate and potash fertilizer should be used.

For relative yields from this plot see Table X.

Colac West (J. McRae).

Mr. J. McRae's plot is situated on a pasture consisting of perennial rye, and subterranean clover, with some flat weed and cape weed. Danthonia persists strongly on the unmanured strips, the pasture previously not having been top-dressed. Superphosphate has given a very good response and a further increase due to the addition of potash has been evident.

Neither lime nor sulphate of ammonia has been of any benefit on this plot. The results are shown in Table X.

Larpent (N. Watchorn).

The pasture here consists of perennial rye, Yorkshire fog, and subterranean clover, together with some flat weed and suckling clovers. The soil is a deep sandy loam, and at the time of commencement of the experiment it was supporting a vigorous pasture. In the autumn before the work was begun, the pasture had received a top-dressing of 1½ cwt. superphosphate per acre, and during the first year the unmanured and treated strips all yielded about equal amounts of produce. In the following years, the response to superphosphate became apparent, but the response to superphosphate and potash is now the most marked feature.

Neither lime nor sulphate of ammonia has effected any appreciable improvement. The relative yields obtained are set out in Table X.

TABLE X.—RELATIVE YEARLY PRODUCTION FROM VARIOUSLY MANURED PLOTS (NEW MOWING TRIALS)—WESTERN DISTRICT, 1935 TO 1938.

Year.	No Manure.	Super. 2 cwt.	Super. 2 cwt., Potash 1 cwt.	Super. 2 cwt., Lime 1 ton.	Super. 2 cwt., S. of A. 1 cwt., Potash 1 cwt.	Super. 2 cwt., Potash 1 cwt., Lime 1 ton.	Potash 1 cwt.
			Cobden (J. Roberts).				
1935 ..	100	135	173	130	162	138	107
1936 ..	100	193	258	195	256	267	110
1937 ..	100	122	193	154	181	218	115
1938 ..	100	153	293	181	292	316	114
			Cobden (L. Vagg).				
1935 ..	100	122	141	125	142	122	98
1936 ..	100	160	185	161	175	176	93
1937 ..	100	142	174	151	158	170	89
1938 ..	100	242	321	252	311	325	111
			Cobden (R. T. Stone).				
1935 ..	100	121	158	110	148	139	135
1936 ..	100	114	202	110	198	195	135
1937 ..	100	103	174	107	175	184	129
1938 ..	100	121	216	123	234	249	132
			Cobden (J. Errey).				
1935 ..	100	118	149	104	170	159	136
1936 ..	100	125	234	118	243	269	152
1937 ..	100	118	174	117	193	205	146
1938 ..	100	126	217	110	268	274	141
			Larpent Park (N. Watchorn).				
1935 ..	100	105	111	103	105	107	100
1936 ..	100	143	176	137	158	162	108
1937 ..	100	130	161	129	154	176	110
1938 ..	100	186	372	174	359	408	116
			Colac West (J. McRae).				
1935 ..	100	230	264	248	248	232	111
1936 ..	100	227	272	232	247	265	110
1937 ..	100	169	208	178	195	212	104
1938 ..	100	217	300	231	304	366	114

Irrigated Pastures

Trials in the Northern Irrigation Areas

By E. T. Beruldsen, B.Sc. (Agric.) Senior Irrigation Officer

In 1935 the work of the Pasture Improvement League was extended to the irrigation areas, and in April of that year plots were commenced in the Kerang and Swan Hill districts. Although these were established under unfavorable weather conditions, they subsequently made a good recovery. These plots were mainly of an observational character, half of each area being laid out as a species and species mixture trial, while the remainder was sown with a uniform mixture of grasses and clovers, with the object of eventually using it for manurial or pasture management trials. Manurial tests of an observational character were laid out at both centres in April, 1936.

During the past year, with the provision of additional transport and mowing equipment, it has been possible to extend the work in the irrigation areas considerably, and mowing trials have been undertaken at four centres, viz., Tongala, Cohuna, Stanhope, and Swan Hill. At Tongala and Cohuna advantage was taken of the fact that Departmental manurial trials on pasture had been established there in May, 1933, on the properties of Messrs. J. Bullingham and G. Major. These plots had succeeded manurial trials on lucerne conducted from 1925 to 1931 on exactly the same locations.

At Stanhope entirely new manurial plots were laid out on a six-year-old established pasture on the property of Mr. E. Hadfield, where pasture establishment trials had been conducted by the Department of Agriculture since 1927. At Swan Hill, the replicated manurial trials on which differential manuring had been carried out for three years were utilized. At each centre half of the manurial trial plots were fenced off from the remainder in June, 1938, and a clearing cut effected with the mower. It was intended to mow and graze these duplicate sets of plots/in alternate years.

Since June, 1938, the plots have been mowed at an average interval of one month. At Stanhope the residual value of the liberal manurial treatment given to the pasture as a whole for some years prior to differential manuring being carried out appears to have obscured any differences in yield which might have been expected. Also, at Stanhope the results have been affected adversely owing to the very unfortunate severe restriction in the supply of irrigation water. The plots at Tongala were slightly affected for the same reason. Until February, water supply was not a limiting factor at Cohuna or Swan Hill. Although only seven months' results are available for purposes of this report, they are most encouraging, especially when it is considered that any increases in yield over the "no manure" checks must be on the conservative side, since stock had free range over all the plots in previous years.

Swan Hill (A. Douglas).

During the 1937-38 season sixteen waterings were applied as contrasted with twelve during the previous season, waterings in the middle of summer being at intervals of one week on some occasions. Correspondingly, the carrying capacity increased from 0.77 cow per acre in 1936-37 to 1.29 cows per acre in 1937-38. This increased carrying capacity indicates the progressive development of the pasture sward under good moisture conditions, and a system of rotational grazing was also partly responsible.

The species trial section has demonstrated that perennial rye-grass, cocksfoot, phalaris, lucerne, white, red, and alsike clovers are well adapted for pasture mixtures on the Murray River flats at Swan Hill. White clover is excellent, and has invaded a section which was originally sown with phalaris and subterranean clover only. The white clover makes an excellent association with phalaris. It is interesting to note the persistence of red clover under these conditions, which at times, on account of its tall-growing character, dominates the pasture. Lucerne is gradually thinning out, Tall fescue has become rank and tussocky, and although the stock eat the tips of the leaves, it is apparently undesirable on this rich heavy ground. Meadow foxtail is becoming a little more conspicuous in patches on the strips originally sown with this species.

Very good results have been obtained on the manurial section with heavy quantities of superphosphate, the highest yield being obtained with 4 cwt. applications. From one plot of this treatment the equivalent of nearly 7 tons of green stuff per acre (80 per cent. moisture) was harvested for the four-week period 13th October to 10th November, 1938. This extraordinary productivity was correlated with the peak of productivity of the perennial red clover.

No other manure in combination with superphosphate has been effective. Good responses were obtained from lime in conjunction with superphosphate, but the increase over superphosphate 2 cwt. only was not so good as the increase obtained with an extra 2 cwt. superphosphate.

Kerang (F. Kane).

The sward on the Kerang plots has continued to improve during the year, mainly through the continued spread of the "irrigation" white clover which was surface sown in the spring of 1936. A contributing factor has been the policy of lenient grazing of the pasture plants. The soil on these plots is of a type which cracks badly on drying out, and a retention of a good cover to minimize this effect is very important.

Phalaris tuberosa has developed very well in this heavy soil, the strip originally sown with this species possessing the densest sward, and this has a binding effect on the surface soil. Outside this strip the pasture is dominantly perennial rye-grass, which exhibits a tufty character. Cocksfoot is becoming more prominent. Tall fescue, which was inconspicuous till this year, has now become very tussocky.

An attempt was made in the autumn of 1938 to establish *Phalaris tuberosa* over a considerable proportion of the plot area with the object of making a better sward, and 4 lb. of seed per acre was sown with the manure when top-dressing. The attempt has apparently failed.

Having observed how *Paspalum dilatatum* had effectively bound the surface soil and prevented a tufty or tussocky sward from developing outside the plot area, an attempt was made in September, 1938, to establish this species by surface sowing on another section of the plots. This also has been a failure, although Mr. Kane had been successful in establishing it in this manner on a pasture adjacent to the plots during the previous summer.

TABLE XI.—RESULTS OF MANURIAL TRIALS ON IRRIGATED PLOTS—SWAN HILL, COHUNA, AND TONGALA (SPRING, 1938).

(Summary of Total Yields obtained per Acre.)

Manurial Treatment per acre per annum.	Pounds Dry Matter per acre.		
	Swan Hill 29.6.38 to 19.1.39	*Cohuna* 28.6.38 to 18.1.39	*Tongala* 22.6.38 to 17.1.39
	lb.	lb.	lb.
No manure	5,038	5,292	4,864
Super. 1 cwt.	4,873	5,504	5,043
Super. 2 cwt.	5,478	6,152	5,280
Super. 3 cwt.	6,567	..	..
Super. 4 cwt.	6,765	7,532	6,490
Super. 4 cwt. (2 applications)	..	6,660	6,423
Super. 6 cwt.	6,721	..	..
Super. 2 cwt. + Amm. Sulph. 1 cwt.	5,434	..	..
Super. 2 cwt. + Pot. Sulph. 1 cwt.	5,280	5,820	5,382
Super. 2 cwt. + Amm. Sulph. 1 cwt. + Pot. Sulph. 1 cwt.	4,983	..	..
*Super. 2 cwt. + Lime 1 ton	..	6,388	6,176
*Super. 2 cwt. + Gypsum 1 ton	..	6,252	5,314
Super. 2 cwt. + Lime 10 cwt.	6,468	..	..
Super. 2 cwt. + Gypsum 10 cwt.	5,434	..	..
Super. 2 cwt. + Amm. Sulph. 1 cwt. + Lime 10 cwt.	5,764	..	..
Bone Fertilizer 2 cwt. ..	..	5,320	5,464

*Note.—Lime and Gypsum applied in 1926, 1929 and 1934 only.

The observational manurial trials at the western end of the plots do not exhibit any outstanding differences, and it is considered that mowing would be necessary to reveal them. Unfortunately, the rough nature of the sward precludes the possibility of mowing at the present juncture.

During the 1937-38 season nine waterings were applied and the carrying capacity for the period of fifteen months, 17th March, 1937, to 30th June, 1938, was at the rate of 4.2 sheep per acre. This was a substantial improvement (34 per cent.) on the results for the previous season. Also, the sheep in this case were big-framed Border Leicester ewes and rams.

Cohuna (G. Major).

The plots at Cohuna were sown in May, 1933, on the site of former lucerne manurial trials. The area of 4 acres was fallowed for some months prior to the seeding of the pasture. An extraordinarily good sward has developed, the mixture being dominantly perennial rye-grass and white clover with a fairly good representation of cocksfoot. During the previous five seasons the pasture had been grazed by cattle and sheep, and records show that the average carrying capacity was the equivalent of ten sheep per acre per annum.

TABLE XII.—MOWING MANURIAL TRIAL—STANHOPE (20TH JUNE TO 19TH DECEMBER, 1938).

(*Pounds of Dry Matter.*)

Manurial Treatment per acre per annum.	Pounds of Dry Matter.	Increase or decrease over "no manure"
	lb.	
No manure	85·1	..
Super. 1 cwt.	80·4	− 1·2
Super. 2 cwt.	74·0	− 2·8
Super. 3 cwt.	102·3	+ 4·3
Super. 4 cwt.	95·2	+ 2·5
Super. 6 cwt.	96·8	+ 2·9
Super 2 cwt. + Amm. Sulph. 1 cwt.	90·7	+ 1·4
Super. 2 cwt. + Pot. Sulph. 1 cwt.	81·8	− 0·8
Super. 2 cwt. + Amm. Sulph. 1 cwt. + Pot. Sulph. 1 cwt.	83·6	− 0·4
Super. 2 cwt. + Lime ½ ton	74·5	− 2·7
Super. 2 cwt. + Gypsum ½ ton	83·7	− 0·4
Super. 2 cwt. + Amm. Sulph. 1 cwt. + Lime 1 ton.	72·2	− 3·2

The plot area is far from being the best land in the district, and is of a rather heavy type, and comparatively low yields of lucerne hay were obtained during the period 1926 to 1931. During that period the water table was seldom more than 3 feet from the surface, which would explain the poor results from the lucerne. Good results were obtained with superphosphate, however.

The production of pasture from this area has far surpassed that obtained from the lucerne in any one year. So far this year's results indicate that 4 cwt. superphosphate per acre is the optimum treatment, and, as in the case of the lucerne, this amount is best applied in one dressing. Both lime and gypsum have given some response at Cohuna, but their effect is not as good nor as economical as that of extra superphosphate.

A few species trials are established on the northern side of the plot area. Here *Phalaris tuberosa* gives promising results.

Tongala (J. Bullingham.

The history of the Tongala plots is identical with that of Cohuna except that the lucerne manurial trials commenced a year earlier in 1925. Yields of up to 6 tons of lucerne hay per acre were obtained in five cuts in one year from the superphosphate 4 cwt. plots, this being aproximately double the "no manure" yields.

An excellent sward of perennial rye-grass, cocksfoot, prairie grass, and white clover is present, and despite the somewhat restricted irrigation this season, high yields have been obtained. Superphosphate 4 cwt. per acre per annum in one application has given the highest yield of pasture clippings. Lime has given a good response, but not so good as extra superphosphate.

Stanhope (E. Hadfield).

The pasture on which the plots are situated at Stanhope was sown down about seven years ago, and a good, fairly uniform sward of perennial rye-grass, cocksfoot. white clover, lucerne, and subterranean clover is present. Cocksfoot is more prominent than perennial rye-grass. The tendency in the Stanhope district is to greatly increase the proportion of cocksfoot when seeding pastures.

The results from the manurial trial to date are inconclusive, since the pasture had been well treated in respect of manure in previous seasons. Further, the shortage of irrigation water this season has had an adverse effect on these plots. From the results of recent cuts, however, the plots receiving large amounts of superphosphate show to advantage.

EXTENSIONS IN DRY PASTURE AREAS—NORTH-EAST DISTRICT.

An extension of the work into the pasture areas of the North-Eastern districts was undertaken during the past year and three complete plots were established at Benalla, Wangaratta, and Kiewa. Each complete plot includes a mown manurial trial, a grazed manurial trial, and a cultivated section sown to various grass and clover species.

The mowing trial plots are similar in design to the newer mowing trials established in the

Western District, the plot strips being long and narrow and laid down side by side, the treatments being replicated three times. The grazing trials differ from those on the old major plots in that while the individual plots are smaller the treatments are more numerous, each trial including seven individually fenced plots. It is not intended that any measure shall be made of the amount of grazing obtained from each plot, their main purpose being to determine the cumulative effect of the repeated annual dressings of fertilizer and the return of animal excrement, both to the bulk of the pasture and to the botanical composition of the sward.

The treatments given are as follows:—

(1) No manure.
(2) Superphosphate ½ cwt. per acre.
(3) Superphosphate 1 cwt. per acre.
(4) Superphosphate 2 cwt. per acre.
(5) Superphosphate 2 cwt. + muriate of potash 1 cwt.
(6) Superphosphate 2 cwt. + potash 1 + lime 1 ton.
(7) Superphosphate 2 cwt. + lime 1 ton.

These plots have been laid down on uniform swards and so far there have been no material growth differences. Should larger differences eventually occur, measurements of these may be made.

The sown sections have been established on ploughed and cultivated land at Wangaratta and Kiewa, while the Benalla area was fallowed over the summer and sown late in March, 1939. The Wangaratta and Kiewa species plots suffered severely from the adverse season, and it is intended that they shall be re-sown this autumn.

During the past spring the Wangaratta mowing plots gave a good response to superphosphate, the heavier dressings showing proportionately greater increases. Smaller increases were obtained on the Kiewa plot, but on neither plot was there any material response to the lime or potash treatment.

The Benalla plot, as yet, has not shown any response to the manurial treatment.

In addition to the above plots established last year in the North-East, plots have also been commenced in the Lilydale district two mowing plots and a grazing manurial trial having been established. All of these plots suffered last year from the adverse season, there being barely sufficient rain to dissolve the applied fertilizers. As a result of this, probably, the manurial responses seen on these new plots were unexpectedly small. With a return to more normal conditions, better manurial responses should be obtained.

Topping pastures in the North-East with modern mowing equipment.

By J. L. Provan, B.Agr.Sc., Senior Horticultural Instructor.

Orchard Notes.

THE orchardist will be turning his attention to the pruning of his trees, and to the application of dormant sprays for the control of various insect pests and fungous diseases. Many of these can be most effectively controlled during the dormant season. It is essential that growers maintain a thorough watch for the presence of San José scale on their trees. This scale insect will cause widespread damage to the trees if it once obtains a hold on them. It is most conveniently controlled by a combined spray of 2 gallons of winter white oil and 5 gallons of lime sulphur made up to 80 gallons with water. Alternative treatments are a straight lime sulphur spray, 1 in 10, or a red oil spray, 1 in 14. Where the infestation is heavy, two applications may be necessary, but in all cases, thorough spraying should be the rule. Red spider, Bryobia Mite, and the Pear Leaf Blister Mite can also be controlled by these sprays. During the latter part of June, a 3 per cent. tar distillate spray should be applied to destroy eggs of the Green Peach Aphid and the Cherry Aphid.

Orchard sanitation has been frequently stressed, but not so enthusiastically practised as its results would warrant. The heavy rains in the Goulburn Valley have revealed the presence of Codling Moth in many pear orchards. The soil around the base of the trees was flooded and the larvae in the soil had to find a safer hibernating place, and they climbed the trunks of the trees and sheltered in bandages and under bark. Where this has occurred, growers can reduce the Codling Moth population by collecting and destroying the bandages and by scraping the bark and removing rubbish from the forks of the trees. The cracked or broken limbs will also require attention.

Growers who contemplate reworking fruit trees, either for the purpose of changing the variety or for providing better pollination, will have to ensure a supply of good scion wood. This is most conveniently collected during the pruning season care being taken to collect only healthy wood. Growers who are taking scions from varieties of apples should be particularly careful not to collect them from trees affected by that common yellow mottling which can be seen in practically every orchard. In some cases, the whole leaf is severely mottled; in others, only occasional small mottling effects are noticed. This mottling can be transmitted by the scion and, if diseased scions are placed on healthy trees, the healthy trees may become affected. Thin, one-year-old laterals of

well-matured wood should be collected for grafting purposes. Tie each variety in a bundle and heel the base of the bundle in moist soil in a shady place. In the spring, these scions can be transferred to the cool store to prevent the buds bursting before the grafting operation.

The Flower Garden.

By A. W. Jessep, M.Agr.Sc., B.Sc., Dip. Ed., Principal, School of Horticulture, Burnley

THE garden should be given a good overhaul in June and any necessary re-arrangements made. Deciduous plants may be transplanted during the dormant period; when this is being done, the roots should be trimmed and the branches cut well back.

Evergreen shrubs, except those which prefer a warm position, may also be shifted during the winter, but new evergreens should be planted out either in spring or autumn; if, however, there is likely to be a shortage of water in summer, autumn is the better time; if planted then they will be established before the arrival of the hot north winds of summer.

Rose Garden.

Now is the most satisfactory time to replace roses. Where roses have been growing previously, it is advisable to remove about a barrow load of soil per plant, and replace it with fairly heavy virgin soil, or at least with soil in which roses have not been recently grown.

There are roses in cultivation to suit almost any position in the garden, except a very shady one. Vigorous growers such as Sunny South are excellent for hedges; for edge plants there are the polyantha types and for intermediate purposes there are climbers, and both bush and standard types. With the exception of blues, almost any colour is procurable, and with a little care when a selection of varieties is being made, blooms may be obtained all the year round. The winter-blooming varieties, such as Lorraine Lee, should be lightly pruned in summer, but not at all in winter.

Roses should be planted 3 feet apart and to about the same depth as that at which they were growing in the nursery. When making the hole, leave a mound in the centre of it, and place the rose on the mound with the roots pointing downwards. Then fill in the hole to about half its depth and trample the soil down with the foot. Fill the hole with water to get rid of excess air and to wash the fine soil particles around the roots. After the water has dispersed, fill in the hole and leave the soil a little higher than the surroundings.

June and July are the best months for pruning most roses, the exceptions being the winter—and spring—bloomers. The winter-flowering types should be pruned in the summer, and the Wichurianas or spring bloomers immediately after they finish flowering. Unpruned bushes become untidy and bare at the base with a few blooms towards the top of the plant.

Pruning is carried out in order to give the bush a good shape and to enable it to produce better blooms over a number of years. The chief factors to be kept in mind are the removal of old wood to encourage healthy strong growth; the removal of any branches growing across the bush, thus enabling more light and sunshine to penetrate it; the cutting out of dead, unhealthy or weak wood, and the shortening back of the remaining strong healthy shoots to a convenient length. Always make the cut immediately above a strong healthy bud and on a slant, so that the water will run off and enable the cut to heal over more quickly.

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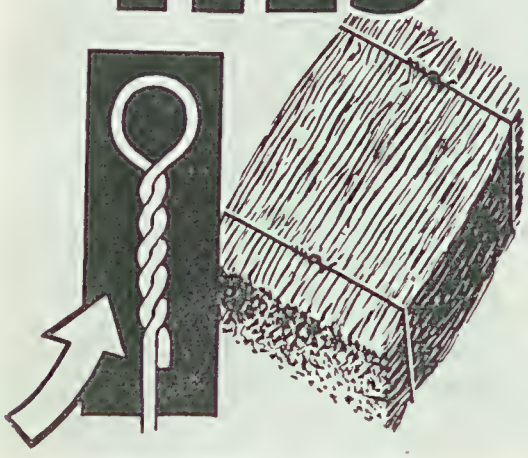

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Whites.—McGredy's Ivory, Mrs. Herbert Stevens.

Climbers.—Black Boy, Climbing Ophelia, Climbing Lorraine Lee.

Wichurianas.—Bush Fire, American Pillar, Paul's Scarlet.

Polyantha.—Ellen Poulsen, Rufus, Salmon Spray.

Vegetable Garden.

June is a quiet month as far as sowing is concerned, but it is a very busy time with the cleaning up of the area and the preparation for spring sowing. During this month, the asparagus bed should be inspected with a view to replacing any dead or unsatisfactory plants and giving it a top-dressing ready for the spring growth. Beds in which summer vegetables were grown should be dug over and left in the rough to enable the frost, rain and air to enter freely and sweeten them.

If the soil is inclined to be sour, give a good dressing of lime and leave it on the surface. Culinary herbs may be taken up and subdivided, and the required number replanted. Small fruits, such as gooseberries and currants, should be pruned, and any plants that have become sickly during the hot weather replaced. Billy Dean and Roaring Lyon are two good gooseberries of the large berry type.

Make plantings of Brown Spanish onions as the main crop and keep the soil well worked around the cabbages and cauliflowers.

If any farmyard manure is available work it into the ground so that it may be well decayed before the time comes for planting out the spring vegetables. When cleaning up the vegetable area, it is advisable to burn any plants that may be diseased or badly infested with pests. On the leaves of the French Bean there is usually Red Spider eggs and sometimes those of Thrips, which, if not destroyed, may carry over to next year.

Make a planting of culinary peas, using an early variety, such as William Hirst. Winter is the time to attend to such work as drainage, transplanting border plants, and culinary herbs, or replacing strawberry, asparagus, and such plants.

Fungicides Act 1935

(*Continued from page* 283.)

foliage, for which, without exception, sprays were blamed. There is little doubt that damage of this description is due to the oxidation or decomposition of the spray compounds. The exact nature of the chemical reactions is not known, but the quality of the insecticide and/or fungicide used may not always be the cause of such trouble; very often it may be traced to the manner in which the spraying operation is conducted and the conditions under which the sprays are applied.

Coarse spraying in heat and bright sunlight will frequently cause damage; the same operation carried out under greater spray pressure with the resultant "fogging" due to better atomization will show no ill-effects.

The list of registered Fungicides, Insecticides etc. will be found in the Supplement to this issue.

Professional Papers

[This section is devoted to professional papers and articles of a scientific character.]

The Influence of Nutrition on the Reaction of Wheat to Urocystis Tritici Koern

By C. R. Millikan, M.Agr.Sc., Plant Pathologist

DURING recent years increasing attention has been devoted by research workers to a determination of the relation of nutrition to the resistance offered by plants to the development of parasitic organisms. As a result, a considerable amount of information exists regarding the effects of nutritional treatments on a variety of host-parasite relationships. Little information is available, however, regarding the nature of the changes induced in the plant by the nutritional treatments, which may be related to its altered disease reaction.

The experiments described in this report were designed, firstly, to investigate the effect of mineral nutrition on the development of flag smut in wheat and, secondly, to determine if any induced changes in the mineral composition of the plant could be correlated with the alteration in the flag smut reaction resulting from the mineral treatment applied. The question as to whether, as is probable, the various treatments induced concomitantly with changes in its mineral composition, other changes in the plant, which were of importance in their effect on the host-parasite relationship, was not studied in this investigation.

The work included sand culture experiments which were conducted in the greenhouse at the Plant Research Laboratory, Burnley, and field mineral treatment experiments, designed to be complementary to the greenhouse work, which were sown in various parts of Victoria as indicated later in this report.

Sand Culture Trials.

In view of the fact that field experiments, referred to later in this report, had shown that flag smut infection could be appreciably influenced by the application of manures to the soil, sand culture experiments were initiated in the greenhouse at the Plant Research Laboratory in 1936. These experiments were designed to determine firstly, the effect of deficiencies or excesses of certain elements on the development of flag smut in the susceptible variety Free Gallipoli and, secondly, the effect of variations in mineral nutrition on the reaction of the resistant Ghurka variety to the disease. In addition it was hoped that the results of this work would assist in interpreting the relation

Fig. 1.—Flag smut culture experiment—Burnley.

between changes in the mineral composition of the plant and its flag smut reaction under field conditions, induced by various treatments.

Method.

Glazed earthenware pots were used for these tests (Fig. 1), their dimensions being 9 inches in diameter (internal measurement), and 20½ inches deep. A side hole, in which a cork could be inserted, was provided at the bottom for drainage purposes. Before filling the pots with sand a small piece of phosphor-bronze gauze was inserted from the inside into the drainage holes to prevent the sand from pouring out during drainage. Cream sand was used which previously had been washed nine times with tap water. After filling the pots the sand in each was leached with distilled water.

In the 1936 experiments four pots were used for each treatment and twelve plants were grown per pot. This arrangement was later found to be unsatisfactory as the standard error calculation for this experiment was very high. In 1937 and 1938, therefore, the number of pots per treatment was increased to six and eighteen plants were grown in each pot. The variance of the results was appreciably reduced by this means.

A series of plots was sown in 1936 with uninoculated seed of Free Gallipoli to determine the symptoms in the wheat plants of the various mineral deficiencies. Seed inoculated with 1 per cent. flag smut spores was used for the remaining pots in that year and in the subsequent experiments. In each year an experiment was sown with the susceptible variety Free Gallipoli (21). In 1937 and 1938, experiments were also sown with the resistant Ghurka variety. In addition to the complete omission of certain minerals from some of the culture solutions applied, excesses of some minerals were tested, while in 1938, the effect on the disease of varying the ratio between various minerals in the solution was studied.

The culture solution employed in 1936 was based on that of Brenchley, Maskell and Warrington (5), its composition being as follows:—

	Grams.
Potassium nitrate (KNO_3) ..	1.0
Di-potassium hydrogen phosphate (K_2HPO_4)	0.3
Magnesium sulphate ($MgSO_47H_2O$)	0.5
Calcium sulphate ($CaSo_47H_2O$) ..	0.5
Sodium chloride ($NaCl$) ..	0.5
Ferric chloride ($FeCl_36H_2O$) ..	0.04
Manganese sulphate ($MnSO_44H_2O$)	0.001
Copper sulphate ($CuSO_45H_2O$) ..	0.001
Boric acid (H_3BO_3)	0.0011
Zinc sulphate ($ZnSO_47H_2O$) ..	0.0011
Distilled water 1,000 c.cs.	

In making up the various solutions, if a base was omitted from the above solution it was replaced by an equivalent amount of sodium, and where a radicle was omitted it was replaced by an equivalent amount of sulphate. In 1937 the calcium sulphate in the above solution was substituted by an equivalent amount of calcium nitrate. This change was made as the 1936 experiment had shown that the calcium content of the solution materially affected the occurrence of the disease. The amounts of minor elements added to the solution were also increased as under:—

Salt.	Grams per litre.
Manganese sulphate ($MnSO_44H_2O$)	0.008
Boric acid (H_3BO_3)	0.008
Zinc sulphate ($ZnSO_47H_2O$) ..	0.008
Copper sulphate ($CuSO_45H_2O$) ..	0.004

This solution was not as satisfactory as the 1936 one as the plants developed a chlorosis which was evidently lime induced, owing to the greater solubility of calcium nitrate as compared with calcium sulphate. The 1938 solution was therefore made similar to that used in 1936 as regards the major constituents. The number and amount of the minor elements added, however, was altered as under:—

Salt.	Grams per litre.
Manganese sulphate ($MnSO_44H_2O$)	0.004
Boric acid (H_3BO_3)	0.004
Zinc sulphate ($ZnSO_47H_2O$) ..	0.004
Copper sulphate ($CuSO_45H_2O$) ..	0.002
Sodium iodide (NaI)	0.0004
Tin chloride ($SnCl_22H_2O$) ..	0.0004
Sodium bromide ($NaBr$) ..	0.0004
Arsenic oxide (As_2O_3)	0.0004
Sodium fluoride (NaF)	0.0004
Cobalt chloride ($CoCl_26H_2O$) ..	0.0004
Barium chloride ($BaCl_22H_2O$) ..	0.0004
Lithium carbonate ($LiCO_3$) ..	0.0004

In certain treatments in 1938, excessive amounts of calcium were applied. These were added to the solutions mainly in the form of calcium nitrate. A small amount of calcium chloride was also included in the solution containing the highest calcium content. The actual treatments applied in each year are set out later.

In 1936 and 1937 the pots received 300 c.c. of solution twice a week. The drainage hole was kept corked, but every three weeks the pots were drained and leached with distilled water. In 1938, 400 c.c. of solution was added once a week, and a similar amount of distilled water three days later. Before the next application of solution the pots were drained. Satisfactory growth was obtained by this method.

At the end of the season, the amount of smut which had developed in the different pots was determined, and the aerial parts of the plants were then forwarded to the Agricultural Research Chemist for ash analyses to determine the effects of the various treatments on the mineral content of the plants.

A statistical examination of the flag smut infection counts was made in accordance with the analysis of variance method (6, 29).

Results.

Details of the sand culture experiments conducted at Burnley during the years 1936 to 1938 inclusive are given below, together with the results obtained in each year. Conclusions are then drawn from the experiments based on a consideration of the results as a whole.

1936.—The effects of deficiencies of the five major elements, nitrogen, phosphorus, potassium, calcium and magnesium on the development of flag smut in the susceptible variety Free Gallipoli were studied. An uninfected series of pots was included to determine the symptoms of these deficiencies in the wheat plant. The results of these observations are given later in this report. The magnesium deficiency treatment together with appropriate control receiving complete solution were sown approximately four weeks after the other treatments.

The effect of the various deficiencies on the development of the disease and on the mineral composition of the plant is given in Table 1. When the experiment was terminated the grain was in the milky stage. Separate analyses were made on the aerial parts of the plants and on the roots.

Table I.—Flag Smut Sand Culture Experiment, Burnley, 1936.—Showing the Effects of Deficiencies of Certain Elements on the Mineral Composition of the Wheat Plant, Expressed as Percentage on Dry Basis, and on the Development of Flag Smut. Variety, Free Gallipoli.

—	Complete Solution.	Nitrogen Deficiency.	Phosphorus Deficiency.	Potassium Deficiency.	Calcium Deficiency.	Complete Solution.	Magnesium Deficiency.
(a) Analyses of leaves, stalks and ears.							
	%	%	%	%	%	%	%
Nitrogen	14·28	14·15	11·77	17·11	13·54	12·26	13·19
Crude Ash	14·69	8·87	9·29	13·53	11·83	14·35	15·46
Silica (SiO_2)	1·15	1·35	1·68	1·88	2·52	0·72	1·07
Silica Free Ash	13·54	7·52	7·61	11·65	9·31	13·63	14·39
Phosphoric acid (P_2O_5)	0·76	0·57	0·15	2·20	0·67	0·55	0·68
Potash (K_2O)	7·09	2·72	3·81	0·35	5·04	7·15	6·32
Lime (CaO)	0·22	0·16	0·35	0·92	0·07	0·29	0·36
Magnesia (MgO)	0·47	0·26	0·36	1·13	0·31	0·43	0·09
(b) Analyses of roots.							
Crude Ash	62·65	45·27	26·90	58·67	38·10	57·94	62·41
Silica (SiO_2)	59·25	41·17	22·55	55·33	34·37	54·79	59·23
Silica Free Ash	3·40	4·10	4·35	3·34	3·73	3·15	3·18
Phosphoric Acid (P_2O_5)	0·34	0·57	0·17	0·63	0·52	0·22	0·26
Potash (K_2O)	0·95	1·65	1·40	0·19	0·79	0·90	0·55
Lime (CaO)	0·43	0·17	0·29	0·31	0·16	0·44	0·60
Magnesia (MgO)	0·11	0·10	0·28	0·13	0·19	0·11	0·05
Flag Smut — Percentage Infection	60·5	42·5	82·9	45·3	0·0	38·6	61·2
Flag Smut — Standard Error	9·8%					9·1%	

A graphical representation of the analyses of the leaves, stalks, and ears, shown in Table I. is given in Fig. 5. This figure shows clearly the very marked influence of the deficiencies, notably potassium deficiency, on the mineral composition of the plant. These analyses are discussed later when details of the deficiency symptoms are given.

Owing to the high standard errors shown in Table I. the value of this experiment, as regards the effect of the several deficiencies on the development of flag smut is somewhat restricted. The outstanding effect on the disease was due to calcium deficiency, which completely inhibited the development of flag smut sori. It was concluded, therefore, that a certain percentage of calcium was essential for the development of flag smut in wheat. Of the other treatments nitrogen and potassium deficiencies both tended to decrease the severity of the disease, and phosphorus and magnesium deficiences to increase it. Owing, however, to the high standard error of the experiment, these changes could not be regarded as significant when compared with the control, but the difference in the effects on the disease of phosphorus deficiency, and either potassium or nitrogen deficiencies, was significant.

1937.—The experiment during this season was designed to obtain confirmation of the results of the 1936 experiment regarding the effects of phosphorus, potassium, magnesium, and calcium deficiencies on the development of flag smut in Free Gallipoli wheat. Two other treatments, namely, Boron Deficiency and Excess Calcium, were also included in this test. In the latter treatment, the nutrient solution contained twice as much calcium as the control solution.

An experiment was also sown in 1937 using the resistant variety Ghurka to determine the effects of unbalanced mineral nutrition on its reaction to *Urocystis tritici*. The treatments tested were as follows:—Complete solution, excess calcium, and deficiencies of phosphorus, potassium and magnesium.

At the end of the experiment the Free Gallipoli plants only were subjected to ash analyses. The results of these analyses and the effects of the various treatments on the development of flag smut in Free Gallipoli are shown in Table II. The experiment was concluded, just as the heading of the plants was commencing.

A graphical representation of Table II. is shown in Fig. 5. Confirmation of the previous

TABLE II.—FLAG SMUT SAND CULTURE EXPERIMENT, BURNLEY, 1937.—SHOWING THE EFFECTS OF THE VARIOUS TREATMENTS ON THE MINERAL COMPOSITION OF THE AERIAL PARTS OF THE WHEAT PLANT, EXPRESSED AS PERCENTAGE ON DRY BASIS, AND ON THE DEVELOPMENT OF FLAG SMUT. VARIETY, FREE GALLIPOLI.

	Complete Solution.	Excess Calcium.	Phosphorus Deficiency.	Potassium Deficiency.	Magnesium Deficiency.	Calcium Deficiency.	Boron Deficiency.
	%	%	%	%	%	%	%
Nitrogen	3·67	3·67	2·67	3·60	3·82	3·86	3·81
Crude Ash	23·28	26·69	13·08	17·62	23·26	24·55	26·70
Silica (SiO_2)	2·32	2·52	1·31	3·45	2·19	3·23	3·25
Silica Free Ash	20·96	24·17	11·77	14·17	21·07	21·32	23·45
Phosphoric Acid (P_2O_5)	2·06	1·79	0·33	2·55	2·31	2·41	2·41
Potash (K_2O)	10·83	10·45	6·00	1·01	11·87	10·64	11·88
Lime (CaO)	0·48	0·62	0·49	0·83	0·33	0·18	0·45
Magnesia (MgO)	0·81	0·77	0·49	1·52	0·17	0·81	0·84
Iron (Fe)	0·047	0·054	0·038	0·063	0·048	0·051	0·051
Manganese (Mn)	0·022	0·021	0·039	0·025	0·016	0·016	0·043
Zinc (Zn) parts per million	33	35	223	68	27	60	52
Flag Smut — Percentage Infection	48·0	83·4	93·3	27·1	51·3	10·6	36·9
Flag Smut — Standard Error	5·8%						

year's results of the effects of deficiencies of calcium, potassium, magnesium and phosphorus on the development of flag smut was afforded by this experiment. Significant decreases in infection were associated with calcium and potassium deficiences (the decrease being greatest in the case of calcium deficiency), while a very significant increase resulted from phosphorus deficiency. Magnesium deficiency resulted in a small insignificant increase in infection, but more reliance can be placed on this change when considered in conjunction with a similar result obtained in 1936.

Whereas in the 1936 experiment calcium deficiency completely inhibited the development of flag smut, 10.6 per cent. infection occurred in the same treatment in 1937. It is to be noted, however, that the degree of deficiency of calcium was greatest in the 1936 experiment (Tables I. and II.).

Excess calcium produced the opposite effect on the development of the disease, resulting in a significant increase in the percentage of infected plants.

The decrease, in infection recorded for boron deficiency is not significant.

The results of the experiment sown in 1937 with the resistant variety Ghurka are shown in Table III.

TABLE III.—SAND CULTURE EXPERIMENT, BURNLEY, 1937.—SHOWING THE EFFECTS OF UNBALANCED MINERAL NUTRITION ON THE DEVELOPMENT OF FLAG SMUT IN THE RESISTANT VARIETY, GHURKA.

Treatment.	Percentage Infection.
Complete solution ..	4.8
Excess calcium ..	19.4
Phosphorus deficiency ..	1.5
Potassium deficiency ..	0.0
Magnesium deficiency ..	3.4
Standard error ..	2.99

Excess calcium in the nutrient solution applied to the plants induced a significant increase in the percentage of infected plants of this variety. It was noted, however, that the greater part of the infection in this variety occurred in small tillers which were produced late in the season. The severity of the symptoms was therefore not great. Phosphorus deficiency, which induced a very appreciable increase in the percentage infection in the susceptible variety experiments (Tables I. and II.), had no significant influence on the incidence of the disease, in the Ghurka variety.

An interesting observation was made during the conduct of the 1937 experiments regarding the effects of the various treatments on the incidence of powdery mildew (*Erysiphe graminis*) on the plants. Towards the end of the season, a certain amount of infection with this fungus occurred on plants in all treatments except those subjected to a deficiency of phosphorus.. Merkenschlager (19) has stated that phosphorus deficient potatoes are less severely attacked by *Phytophthora infestans*, and grapes by *Plasmopara viticola*.

1938.—The treatments included in the 1938 experiments were designed on the basis of the results of the previous experiments, to induce variations in the reaction of the wheat to *Urocystis tritici* by alteration in the ratios of certain of the mineral constituents in the solutions supplied to the plants. It was hoped by this means to investigate further the relative importance of the various elements in influencing the flag smut reaction of the plant. Both the susceptible variety Free Gallipoli and the resistant variety Ghurka were used, the treatments included being:—

Free Gallipoli.—Complete solution, calcium deficiency, 4Ca, 2Ca, 2Ca $\frac{1}{4}$Mg, 2Ca $\frac{1}{4}$Mg $\frac{1}{10}$P, 2K and 2P-K.

Ghurka.—Complete solution, 2Ca, 2Ca $\frac{1}{4}$Mg, 2Ca $\frac{1}{4}$Mg $\frac{1}{10}$P, 2K, 2Ca $\frac{1}{4}$Mg 2N.

The numbers or fractions, and the elements listed in the above treatments indicate which constituent has been varied in that treatment and the magnitude of the variation, when compared with the complete solution. For example:—The calcium content of the 2Ca treatment was twice that of the complete solution. Also $\frac{1}{4}$Mg indicates that there was only one-quarter the amount of magnesium in this solution as was present in the complete solution.

The experiment in this year was terminated after flowering of the plants had occurred.

In addition to the percentage infection, the severity index of the flag smut which developed in the various treatments was obtained by the method described in the section of this report dealing with the field experiments.

Both the Free Gallipoli and the Ghurka plants were submitted for ash analyses, the results of which are shown in Table IV.

A graphical representation of the Free Gallipoli analyses in Table IV. is shown in Figure 5.

TABLE IV.—FLAG SMUT SAND CULTURE EXPERIMENT, BURNLEY, 1938.—SHOWING THE EFFECTS OF THE VARIOUS TREATMENTS ON THE MINERAL COMPOSITION OF THE AERIAL PARTS OF THE SUSCEPTIBLE VARIETY FREE GALLIPOLI AND THE RESISTANT VARIETY GHURKA, EXPRESSED AS PERCENTAGE ON DRY BASIS, AND ON THE PERCENTAGE AND SEVERITY INDEX OF THE RESULTANT FLAG SMUT INFECTION.

—	Complete Solution.	Calcium Deficiency.	4 Ca.	2 Ca.	2Ca¼Mg.	2Ca¼Mg $\frac{1}{10}$P.	2 K.	2 P–K.	2Ca¼Mg2N.	Standard Error.
	..	..	..	..	..	..	..	..	..	..
(a) Free Gallipoli.										
Crude ash	18·72	18·65	16·86	17·34	17·51	12·72	17·74	16·26	..	..
Silica	1·24	2·07	1·42	1·72	1·44	1·13	1·08	2·00	..	..
Silica—Free ash ..	17·48	16·58	15·44	15·62	16·07	11·59	16·66	14·26	..	..
Lime (CaO)	0·51	0·25	0·77	0·73	0·75	0·50	0·40	1·01	..	..
Magnesia (MgO) ..	0·68	0·89	0·60	0·70	0·48	0·37	0·62	1·51	..	..
Potash (K_2O) ..	7·82	7·87	7·90	7·85	8·63	6·13	9·40	2·93	..	..
Phosphoric Acid (P_2O_5)	1·08	1·53	0·87	1·05	1·20	0·35	1·14	2·22	..	..
Ammoniacal nitrogen ..	0·120	0·077	0·076	0·117	0·067	0·038	0·031	0·133	..	..
Zinc (Zn) parts per million	10	10	10	8	10	30	10	20	..	..
Flag Smut — Percentage infection	47·9	11·5	70·6	64·1	60·1	73·7	43·9	31·2	..	5·70
Flag Smut — Severity Index	33·6	7·3	45·5	51·0	47·3	63·8	31·7	27·5	..	5·56
(b) Ghurka.										
Crude ash	17·00	..	..	15·73	16·34	10·59	17·76	..	16·42	..
Silica	1·20	..	..	0·89	0·89	0·83	0·97	..	1·01	..
Silica free ash ..	15·80	..	..	14·83	15·45	9·76	16·79	..	15·41	..
Lime (CaO)	0·54	..	..	0·67	0·69	0·43	0·42	..	0·67	..
Magnesia (MgO) ..	0·65	..	..	0·55	0·40	0·31	0·57	..	0·44	..
Potash (K_2O) ..	7·89	..	..	7·40	8·01	5·27	8·85	..	7·58	..
Phosphoric Acid (P_2O_5)	0·98	..	..	0·87	0·99	0·43	1·11	..	1·15	..
Ammoniacal nitrogen ..	0·075	..	..	0·047	0·051	0·013	0·029	..	0·045	..
Zinc (Zn) parts per million	8	..	..	2	10	15	12	..	15	..
Flag Smut — Percentage infection	7·6	..	..	10·1	16·1	1·1	6·4	..	4·9	3·37
Flag Smut — Severity index	4·7	..	..	5·5	8·0	1·1	3·2	..	2·4	1·67

Further confirmatory evidence was obtained in the Free Gallipoli section of this experiment regarding the effects, firstly of calcium deficiency in significantly reducing the severity of flag smut in the plants, and secondly of excess calcium in increasing the incidence of the disease. In this regard it is of interest to note that the 4Ca treatment did not induce a significant increase in the severity index such as resulted from the 2Ca treatment. The most severe infection developed in the 2Ca ¼Mg $\frac{1}{10}$ P treatment.

None of the treatments applied to the Ghurka variety in this experiment increased its flag smut susceptibility to a point where it was in any way comparable with that of the susceptible control plants grown under the same conditions. The general effects of the treatments on the severity of the disease were similar to those which were induced in the susceptible variety, with the exception of the 2Ca ¼Mg $\frac{1}{10}$ P treatment, where the opposite effect took place.

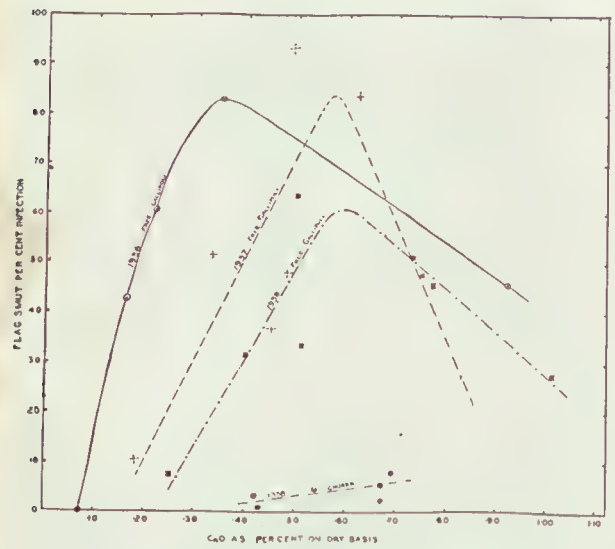


Fig. 2 Graph showing the relation between variations in the calcium content of the plants, induced by the treatments, and the development of flag smut, 1936-1938. Note.—The flag smut in the 1938 experiments is expressed by the severity index.

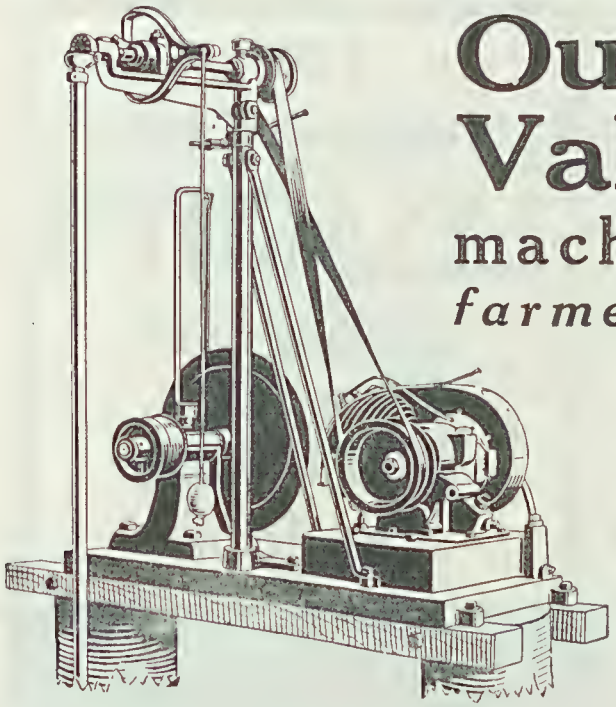
The critical period during which nutritional treatment would be expected to exert an influence on the development of flag smut in the plant is from germination to the date of appearance of the sori. Chemical analyses, therefore, which were made on the plants from these experiments at the end of the season do not accurately represent the actual composition of the plants during this stage. As, however, the plants grown in the various treatments were subjected to those treatments during their whole growing period, it is considered that the relative differences in the chemical composition of the plants during the critical period would be similar to the differences revealed by the analyses made at the end of the experiments.

Scatter diagrams of the relation between the flag smut which developed in any treatment and the mineral composition of the plant were made. Each individual constituent analysed in the experiments conducted during 1936 to 1938 inclusive was examined separately. Only in the case of the lime (CaO) content of the plant could any relationship be demonstrated. This relationship is shown in Figure 2, and indicates that in the case of a susceptible Free Gallipoli variety the variations in the calcium concentrations in the plants. induced by the different treatments, was such that an optimum concentration for the development of flag smut occurred. Above or below this point the severity of the disease was decreased. This relationship is similar to that demonstrated in the field experiments, referred to later in this report.

In the case of the resistant Ghurka variety the relationship between calcium concentration and smut reaction is not so clearly defined (Figure 2), owing, firstly, to the fact that the variations in the calcium concentrations in the plants induced by the several treatments included in the 1938 experiment were not as wide as those induced in the susceptible variety, and, secondly, to the fact that the variations in the flag smut reaction of this variety were not great.

Further evidence over a wider range of calcium concentrations is therefore necessary before the relationship between this constituent and flag smut reaction can be definitely established in the case of the resistant variety. The existence of some relationship is indicated by the fact that an excess of calcium in the nutrient solution in the 1937 experiment resulted in a significant increase in the percentage of flag smut (Table III.).

The Field Mineral Treatment tests associated with the above investigation will be dealt with in a subsequent issue of this Journal.



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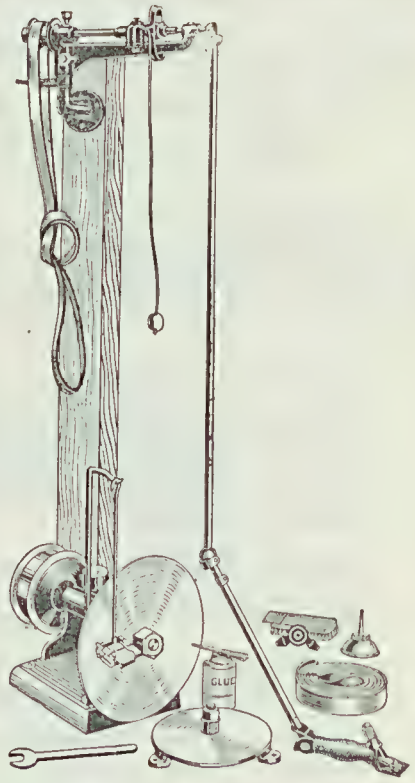

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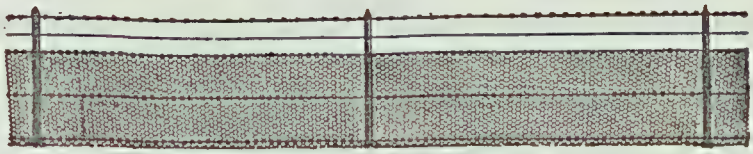

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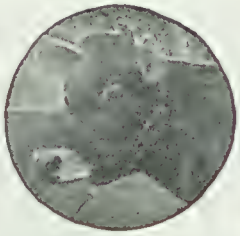

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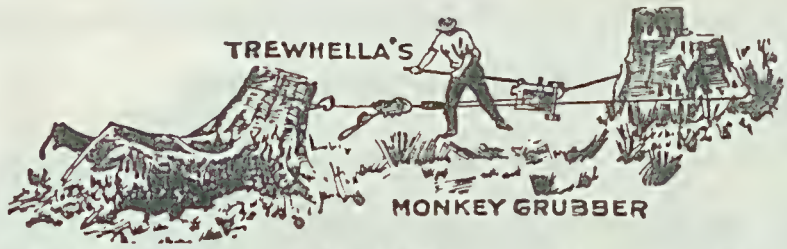

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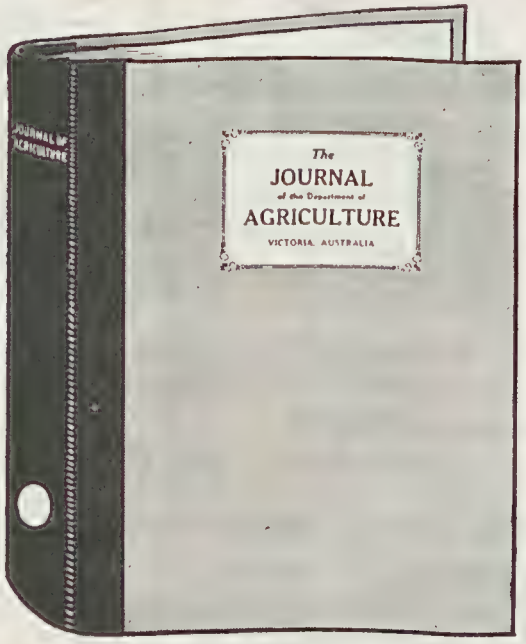

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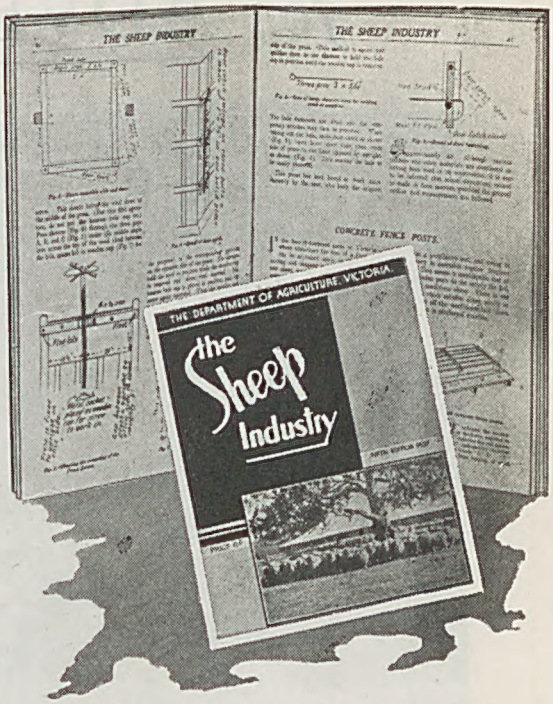

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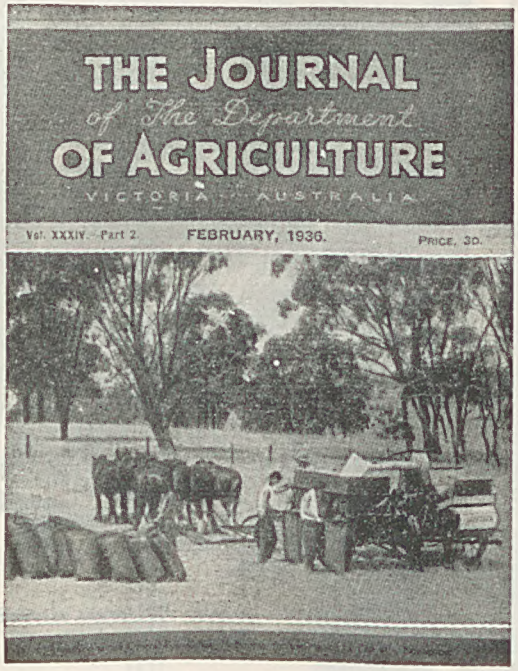

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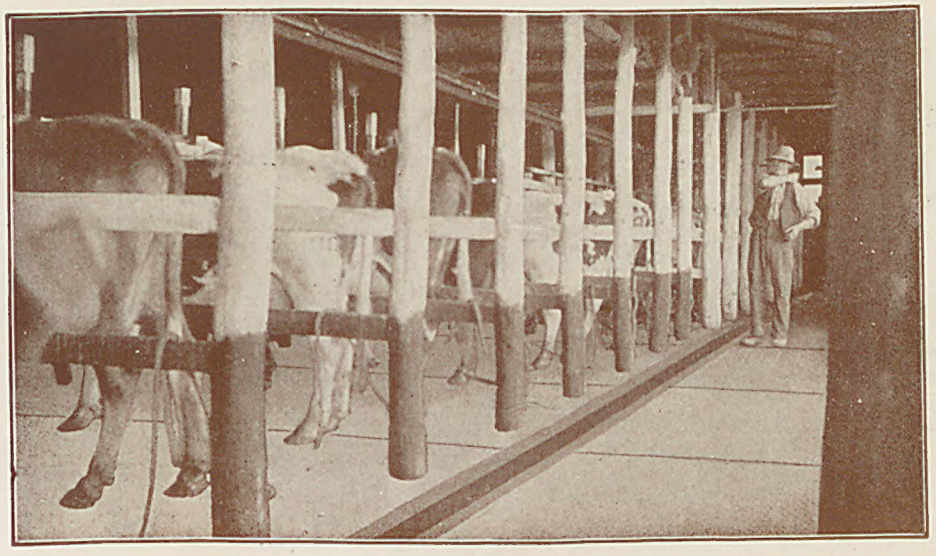

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